Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

1010 EMPIRE BUILDING | March, 1944 | PITTSBURGH, PA.

Three years of Tough Service WITH TIMKEN BEARINGS TAKING THE THRUST

19" diameter non-ferrous piercing mill built by Aetna-Standard Engineering Company, Youngstown, Ohio, and equipped with Timken Bearings.

This Aetna-Standard non-ferrous piercing mill has been in operation at the plant of the Lewin Mathes Company, St. Louis, for something over three years. It is equipped with Timken Tapered Roller Bearings on the main roll necks, in the gear drives and thrust block. These bearings have borne the brunt of this severe service; are still going strong—and will be for years to come.

Timken Bearings contribute importantly to the speed, accuracy, endurance, low maintenance and long life of all kinds of steel mill equipment through their ability to eliminate friction; carry radial, thrust and combined loads; and hold moving parts in correct and constant alignment.

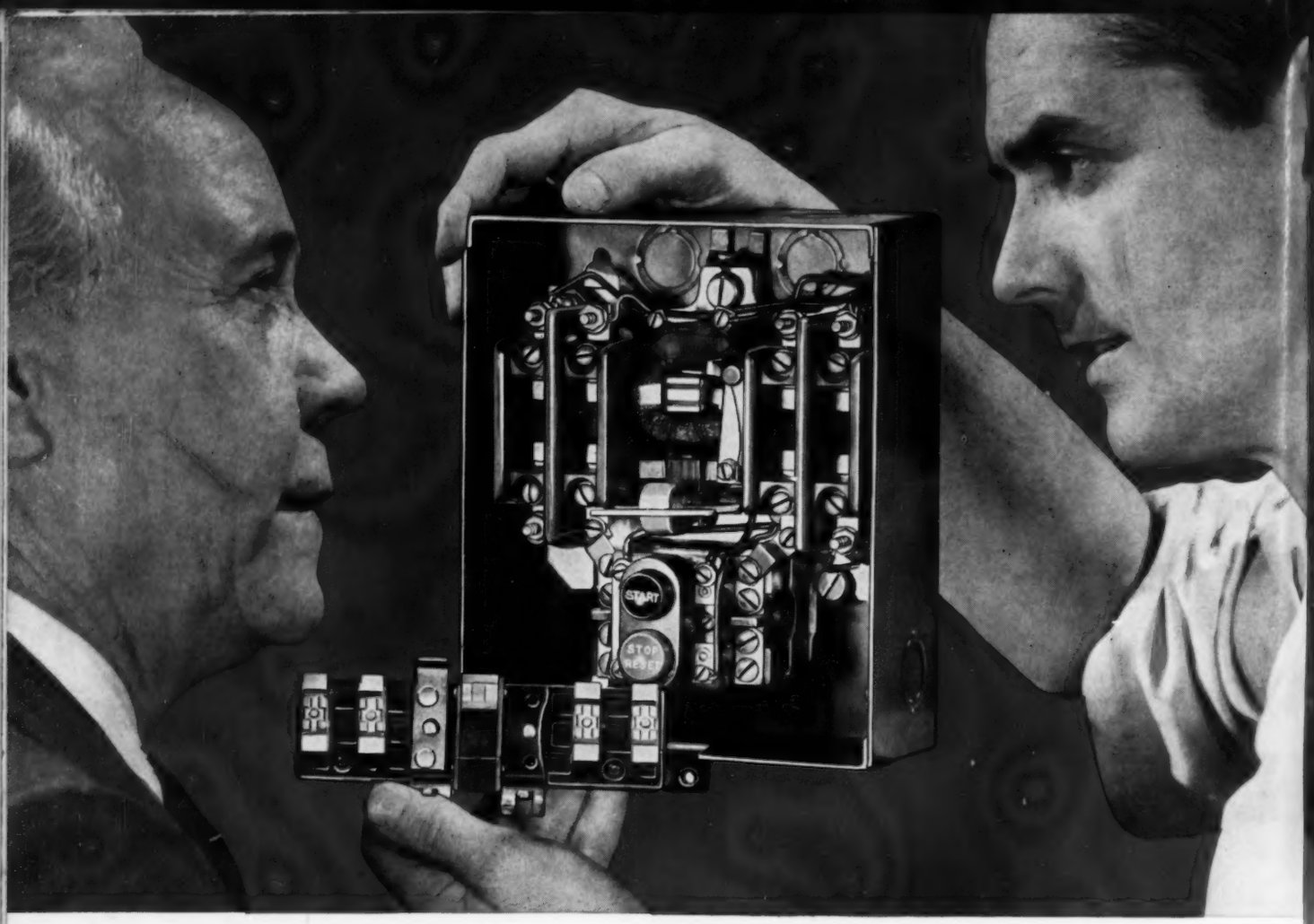
Timken Roll Neck Bearings hold all records for tonnage rolled and low bearing cost per ton. They can be applied to any mill—old or new.

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



VERTICAL CONTACTS *in Motor Control*

Superb Engineering . . . and Good Common Sense

With America's factories playing such an important part in shaping the future of mankind, *millions* of people know the vital job being done by electric motors and the resulting *importance* of dependable motor control. Thus the widespread preference for Cutler-Hammer Vertical Contact Motor Control is easily understood. Not only does the performance of *this* motor control speak for itself but the *reason* for such performance is obvious, easily appreciated, fully convincing. Electrical experts like to say the vertical contact construction in Cutler-Hammer Motor Control is superb engineering. But we rather like the way hard-boiled maintenance men put it . . . "Vertical Contacts make sense. I wouldn't buy any other kind of motor control". That tells the real story of an outstanding engineering achievement . . . why the vast majority of all electric motor manufacturers recommend Cutler-Hammer Motor Control, why leading machinery builders feature it as standard equipment, why a host of electrical wholesalers carry it in stock for your convenience. CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

Dust Safe

Everyone knows *clean* contacts are the *first* requirement for smooth-operating, dependable motor control. Anyone can see vertical contacts *can't* collect dust and dirt like horizontal surfaces—must *stay* clean and perform better.

Arc Safe

By their very design, vertical contacts form a flue or "chimney" wherein naturally induced rising air currents act to automatically extinguish the arcing which occurs when contacts are opened. This means longer-life motor control.

Secret Safe

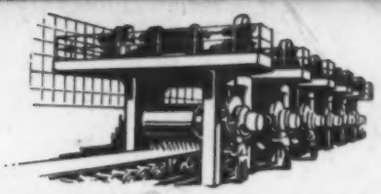
Vertical contacts are out in the open, easy to inspect, simple to service. They are designed to *avoid* the destructive effects of confined heat and arcing . . . do not merely *hide* them until major damage develops.

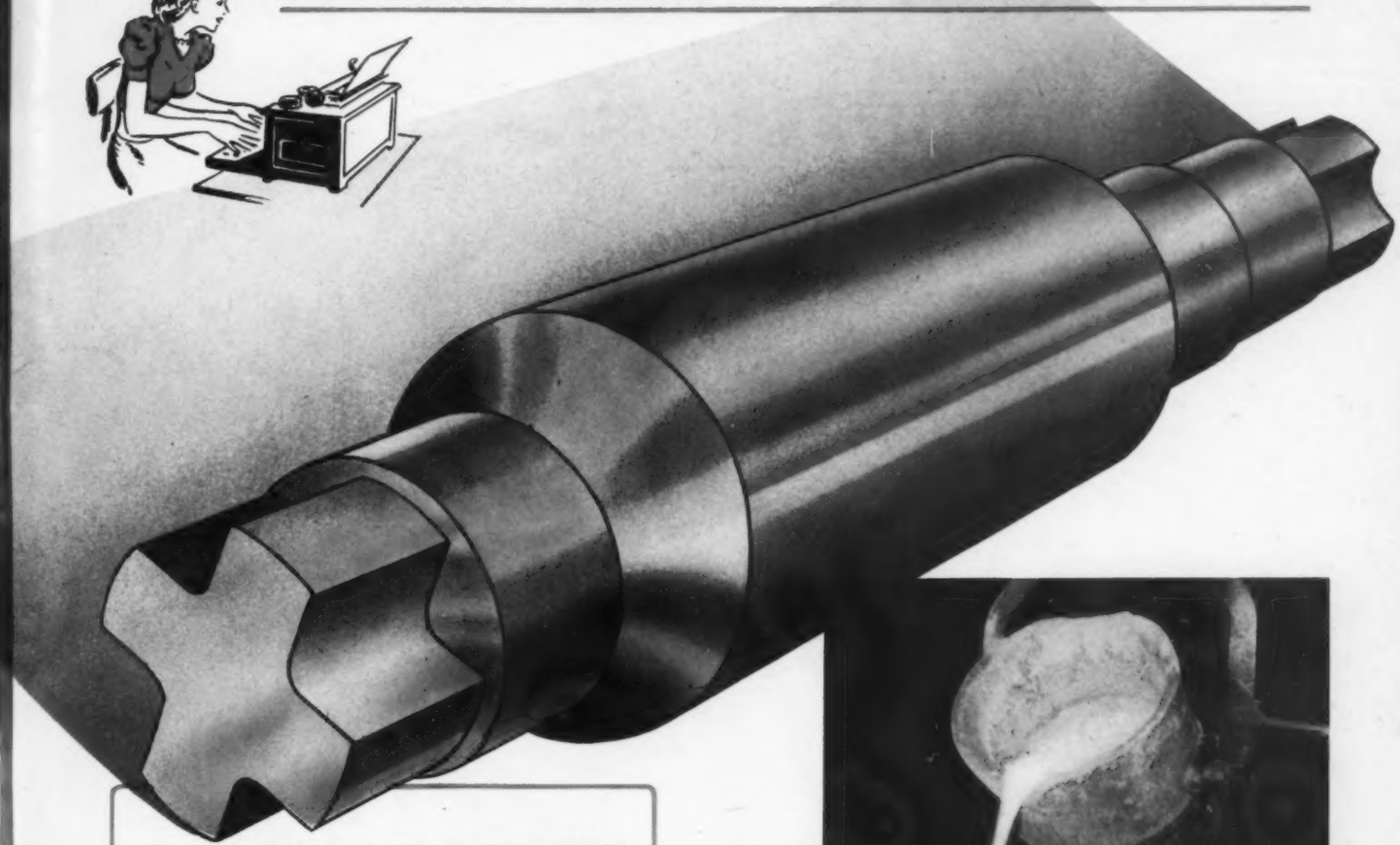
CUTLER-HAMMER
MOTOR CONTROL
C-H

Copyright 1944, Cutler-Hammer, Inc.

Engineering Excellence Finds its Greatest Reward in the Respect and Confidence of those it Serves

"Same Roll Specification as Last Time... **ROLLS BY AETNA-STANDARD"**





Casting Aetna-Standard Rolls

There is an Aetna-Standard Size and Type of Roll for Every Purpose . . . . . .

Sizes . . . from rolls for an 8-inch mill, all intermediate sizes, up to large plate mill rolls, 34" x 206".

Plain Chill	Alanite	ing, and Sizing
Moly Chill	Grain	rolls for steel
Nickel Chill	Asex	pipe, rolls for
Alanite	Asex Special	rubber and plas-
Special	Forming, Weld-	tic mills.

● For thirty years, Aetna-Standard has been supplying cast iron base rolls not only for steel and non-ferrous mills, but also for rubber and now for plastic mills.

Our metallurgists exercise extreme care in selecting the right analysis and the correct type of roll for your specific application. The experience and skill carries right on through the plant. Dependable workmen apply their respective talents on each manufacturing step of your roll order from the casting operation to final inspection. The combination of experienced personnel and ample facilities enables Aetna-Standard to incorporate the same high quality in roll order after order.

FACTS ABOUT AETNA-STANDARD

From the designers and engineers who have developed many innovations for the steel and allied industries to the machinists who produce the precision parts, Aetna-Standard has a group of men who apply their experience to every job. That is why Aetna-Standard rolls and other equipment always measure up to original specifications and expectations.

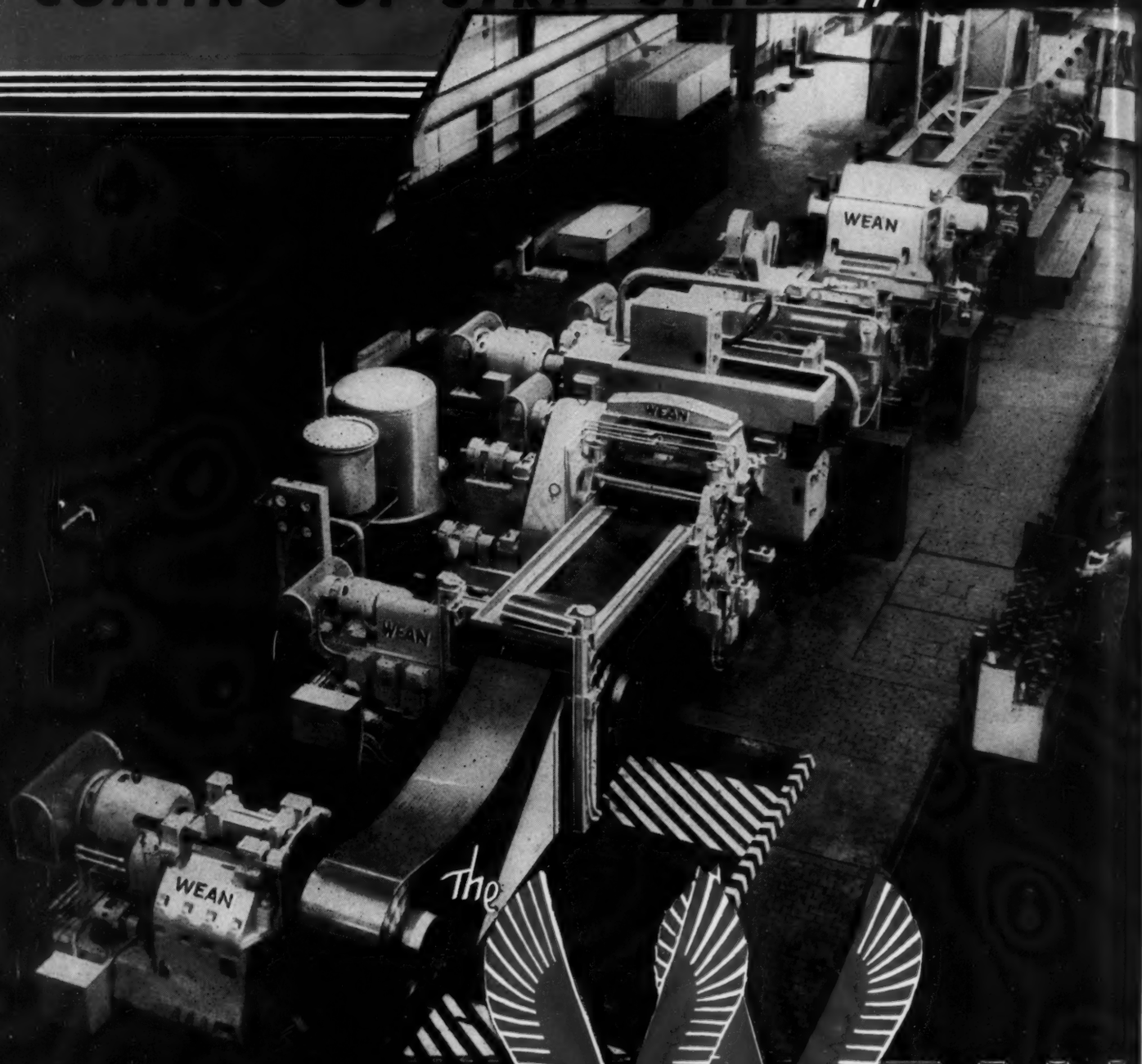
The AETNA-STANDARD ENGINEERING COMPANY
YOUNGSTOWN · OHIO · U.S.A.
ARMY E NAVY

DESIGNERS AND BUILDERS TO THE STEEL, NON-FERROUS AND CHEMICAL INDUSTRIES

ASSOCIATED COMPANIES:

HEAD, WRIGHTSON & COMPANY, LIMITED, THORNABY-ON-TEES, ENGLAND
JOHN INGLIS COMPANY, LIMITED, TORONTO, ONTARIO, CANADA

WEAN EQUIPMENT FOR THE CONTINUOUS COATING OF STRIP STEEL

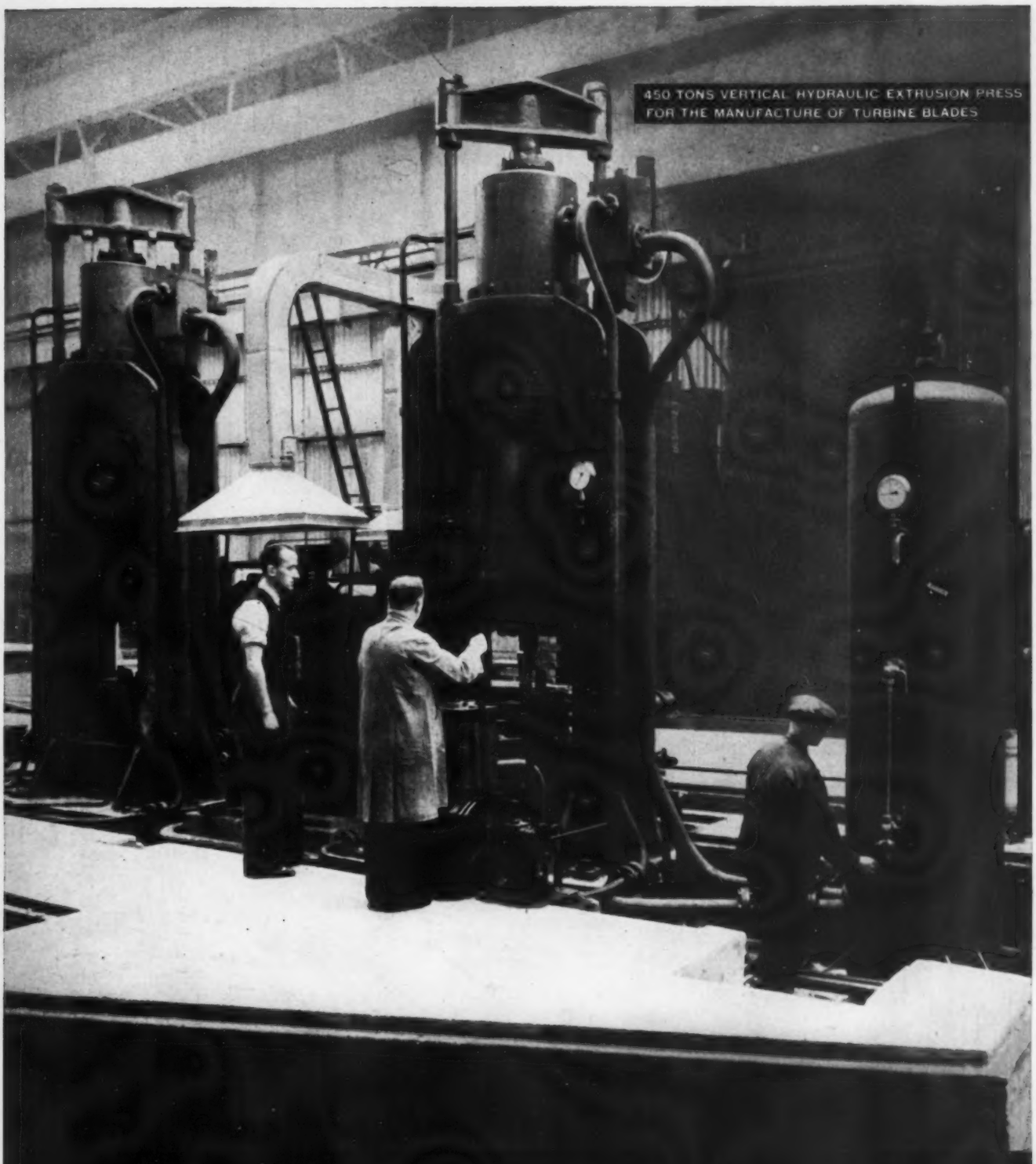


THE Wean Engineering Company is meeting today's demand for equipment to produce tin plate and zinc coated strip steel with light coatings by the electrolytic method; also equipment to produce chemically treated black plate and strip steel. Equipment for coating strip steel with zinc and other materials by the hot dip method is also available.

The WEAN ENGINEERING COMPANY, Inc.
Warren, Ohio

Subsidiary Company
THE BRODEN CONSTRUCTION CO.
CLEVELAND, OHIO

SPECIALISTS IN SHEET, TIN AND STRIP MILL EQUIPMENT



HYDROPRESS · INC.

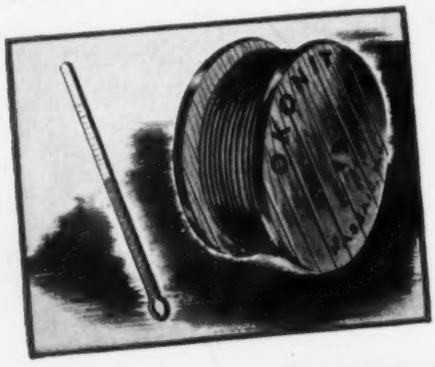
ENGINEERS CONTRACTORS

HYDRAULIC PRESSES · ROLLING MILLS
STRETCHERS · PUMPS · ACCUMULATORS

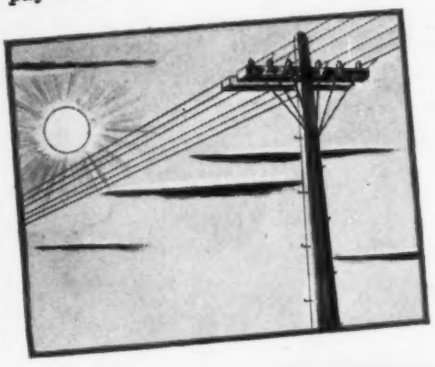
570 LEXINGTON AVENUE · NEW YORK · N. Y.

HOW TO PROTECT WIRES AND CABLES FROM THEIR ENEMY—HEAT

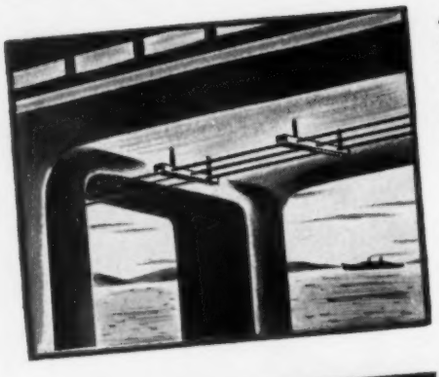
Heat is a serious threat to the long life and efficiency of electrical wires and cables, destroying covers and insulation on the reel and on the job. Yet a few simple precautions can go far to extend the life of the cable or wire. In operation, the more you reduce the temperature of the surrounding air, the longer insulation will last with the same conductor load. Or, if necessary, more current can be carried in the same cable without shortening its life. Here are some suggestions that will pay well:



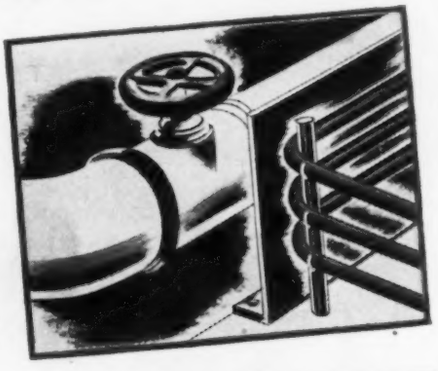
STORE CABLES IN A COOL — NOT COLD — PLACE. Stored in a cool, uniform temperature, cable insulation is maintained in the best condition for the longest possible life. Avoid extreme temperatures Keep cables under cover.



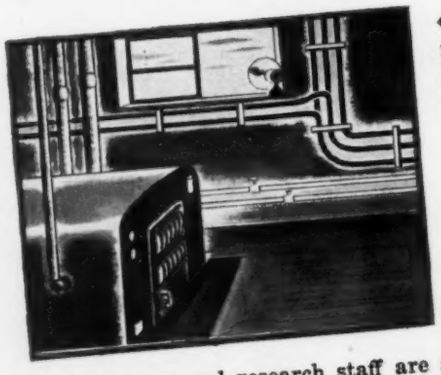
INSTALL RISER CABLES ON THE NORTH or most shaded side of poles — away from the heat of the sun.



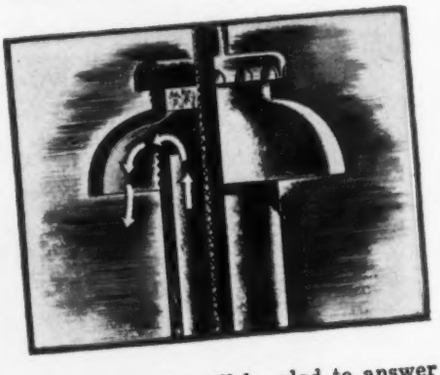
ON BRIDGES, VIADUCTS, ETC., PLACE CABLES BELOW THE STRUCTURE for protection from sun and weather. This also is more likely to add protection against accidental mechanical damage, vandalism and sabotage.



NEAR HEATING UNITS or hot pipes, move the wiring or insert baffles between the source of heat and the cables to deflect hot air.



IN HOT LOCATIONS—cut air vents in the ceiling or partition above cables to provide adequate circulation by means of natural convection or install fans.



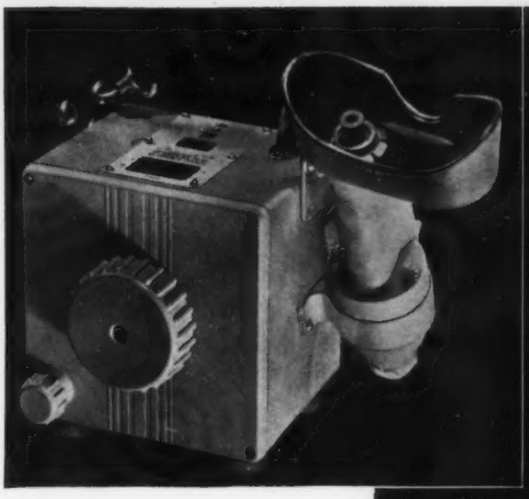
VENTILATE POLE RISER CONDUITS and create circulation by making openings near the top or by leaving space between the conduit and pothead. This can improve the efficiency of an entire circuit.

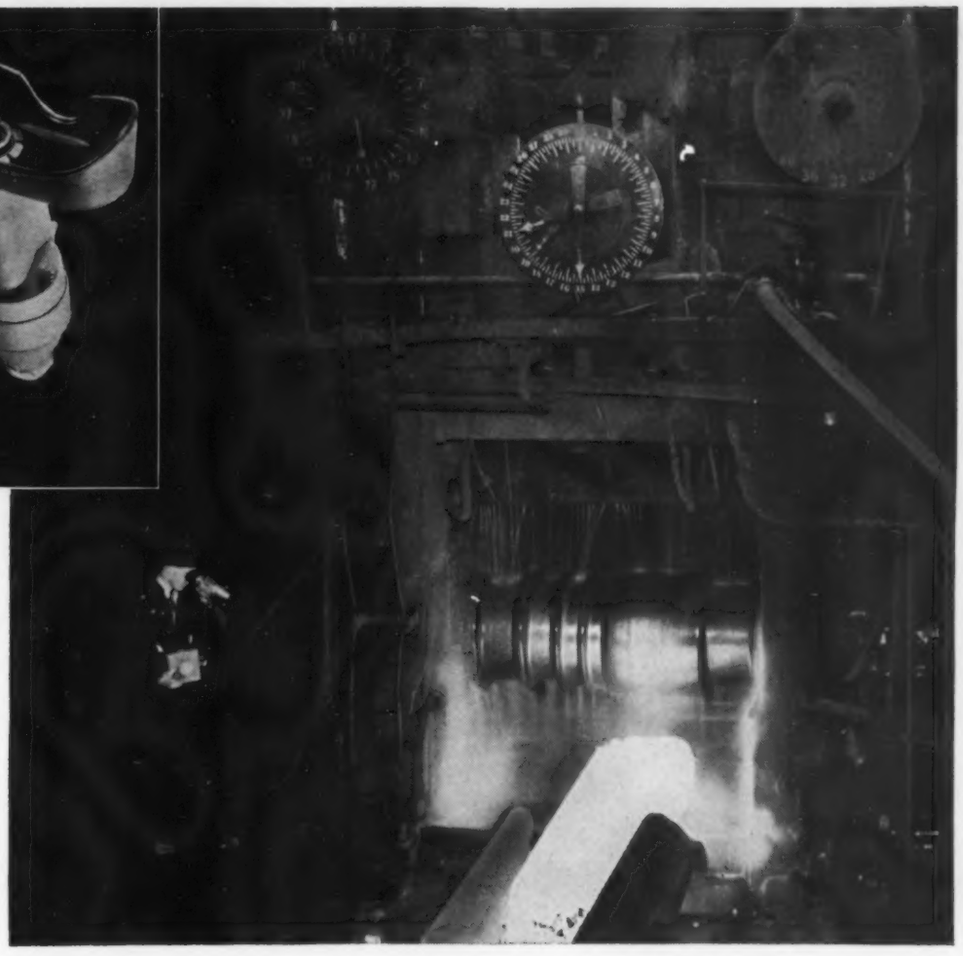
Our engineers and research staff are anxious to help you prolong cable life. We will be glad to answer questions which may help you solve problems concerning protection and longer use of your electric wires and cables. No obligation is incurred by this service. The Okonite Company, Passaic, New Jersey.

OKONITE

Insulated Wires and Cables

3587





Above — L&N Direct-Reading Potentiometer-Type Optical Pyrometer, with Telescope in carrying strap on Control Box.

Right — Rolling-mill temperatures were among the first uses of L&N Optical Pyrometers, many years ago. The added speed of the Potentiometer Optical makes it even better suited to this service.

SPEED AND TWO OTHER FEATURES

Mark L & N OPTICAL *Potentiometer* PYROMETERS

Speed, accuracy and a direct-reading scale are the three features which make the L&N Optical Potentiometer Pyrometer the logical choice for measuring the medium and high temperatures of industry. Lightweight and rugged construction are additional advantages in operations where the instrument is in steady service.

Operation is simple. When the user sights through the instrument's telescope, he sees the hot object with great clearness, and outlined against it he also sees the glowing filament of a small electric lamp. The user simply turns the large knob on the box until this filament vanishes against the hot object; then turns the smaller knob until a pointer on the box comes to zero; and the temperature scale turns simultaneously to the correct temperature, in degrees.

The operation is so obvious and exact that different inspectors, on the same process, will closely match each others' readings — a great advantage if more than one inspector checks a process, or if one man checks the charging temperature of a ladle and another checks its pouring temperature.

L&N Optical Pyrometers are made in three Fahrenheit and three Centigrade ranges, as follows: 1400 to 3200 F and 1400 to 5200 F for black-body temperatures, and 1400 to 3200 F for molten-metal temperatures; also 775 to 1750 C and 775 to 2800 C for black-body temperatures, and 775 to 1750 C for molten-metal temperatures.

An L&N engineer will be glad to call on you regarding the use of an L&N Optical, or will send Catalog N-33D, as you prefer.

depends on me!

A Slogan For Every American

LEEDS & NORTHRUP COMPANY, 4942 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-33D(5a)

Whether you're a catcher or the Purchasing Agent, it's the tons per stand per day that tell you when your rolls are "right". In mills equipped with Lewis Rolls you'll find high tonnage at low cost, more rolls between grinds.

LEWIS FOUNDRY & MACHINE DIVISION of Blaw-Knox Company
P. O. BOX 1586, PITTSBURGH, PA.

ARMY E NAVY

Also manufacturers of
ROLLING MILL MACHINERY
for the iron, steel and non-ferrous industries

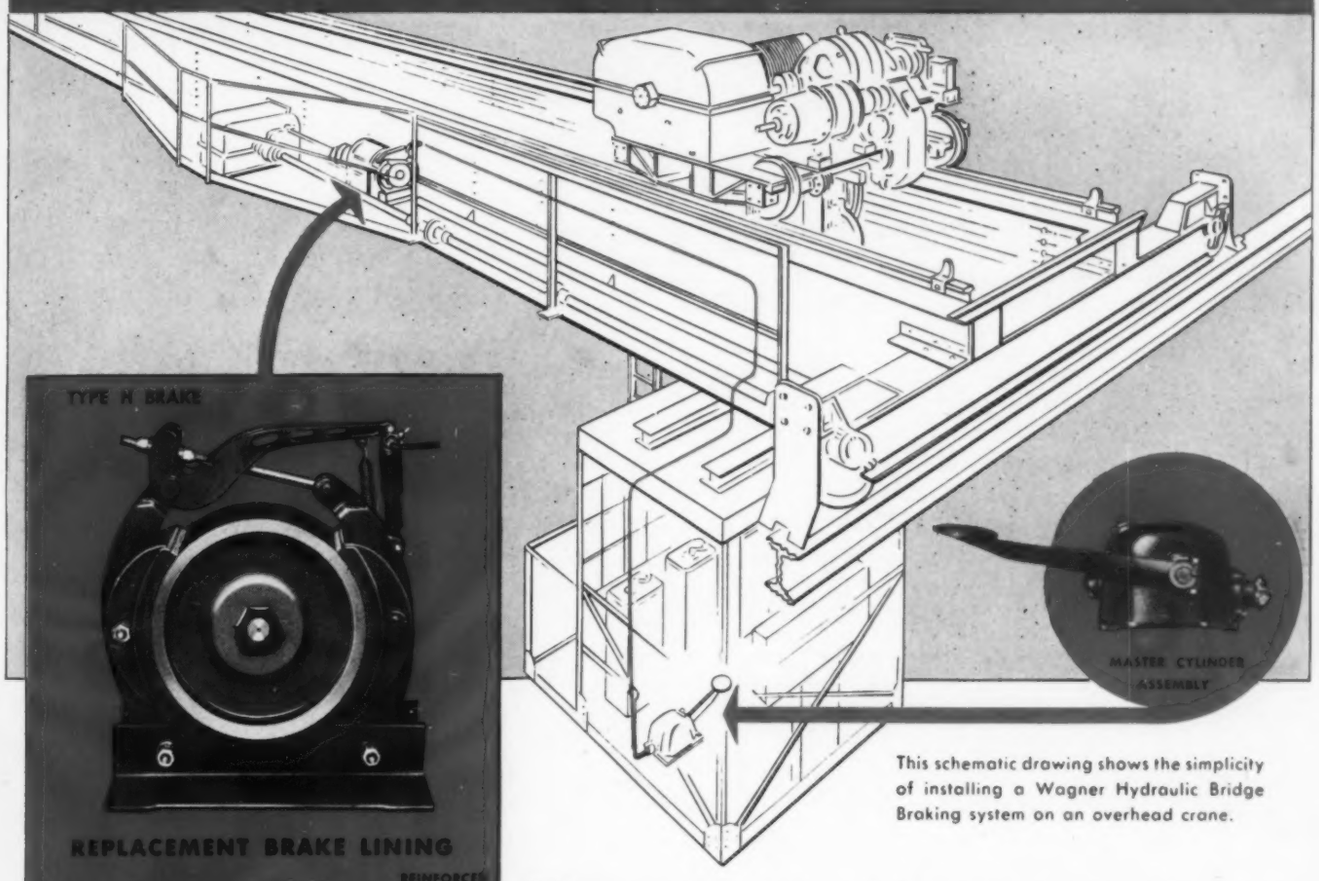
BUY U. S. WAR BONDS AND STAMPS

LEWIS ROLLS

Wagner

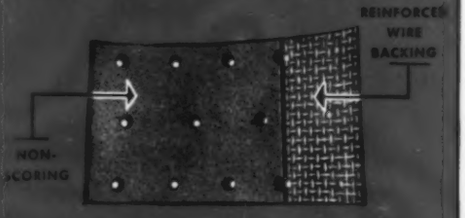
HYDRAULIC BRAKING SYSTEMS

help you speed production SAFELY and ECONOMICALLY



This schematic drawing shows the simplicity of installing a Wagner Hydraulic Bridge Braking system on an overhead crane.

REPLACEMENT BRAKE LINING



Wagner industrial brake lining is preformed in blocks to fit all makes and sizes of crane brakes and other industrial brake applications.

WAGNER Hydraulic Bridge Brakes provide braking controls comparable to the braking system on the modern passenger car or commercial vehicle. The Wagner Hydraulic Bridge Braking system utilizes either an external or internal brake unit, which is actuated by hydraulic pressure developed in a foot-operated master cylinder—Just like stopping your automobile . . . heavy crane loads can be brought to quick, safe, smooth stops. Wagner Hydraulic Bridge Brakes are simple to install. They are available in complete kits, including everything necessary—brake assembly, brake wheel, master-cylinder, wheel cylinder, tubing, flexible hose, brake fluid and all fittings.

WRITE FOR BULLETIN IU-20—It gives complete information on Wagner Hydraulic Bridge Braking Systems and Wagner Industrial Brake Lining. 144-4

MOTORS
TRANSFORMERS
UNIT SUBSTATIONS
INDUSTRIAL BRAKES
BRAKE LINING

Wagner Electric Corporation
ESTABLISHED 1891
6483 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

ARMY E NAVY
NATIONAL SECURITY AWARD

BACK THE ATTACK—BUY U. S. WAR BONDS

UNITED

Continuous Electrolytic Plating Lines

★ ★ ★ HIGHEST SPEED PRODUCTION

★ ★ PLATES ONE OR BOTH SIDES

★ SAVES CRITICAL MATERIAL

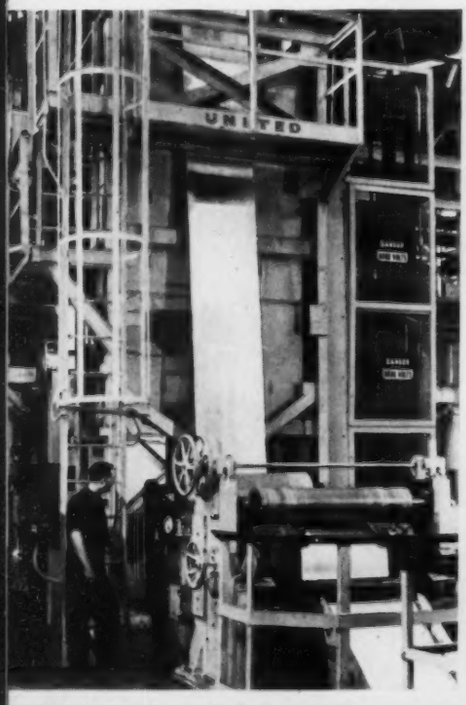
Developed in collaboration with the Hanson-Van Winkle-Munning Company of Matawan, N. J., UNITED CONTINUOUS ELECTROLYTIC PLATING LINES take strip steel in coil form from Cold Rolling Mills, and after side-trimming, cleaning and pickling, deposit tin on the strip electrolytically, producing finished tinplate at the rate of 1000 feet or more a minute, many times faster than by conventional hot dip methods. (★ ★ ★ *Up to 1300 feet per minute.*) ★ ★ One side of the strip, or both sides at the same time, may be plated with either a similar or dissimilar material in any desired thickness of coating. ★ Only about 1/3 as much tin is required than would be needed to produce the same amount of plate by hot dipping.

Comparable savings of time and metal are effected in the application of *zinc* coatings, with the added advantage of producing, by the electrolytic process, a tighter bond between zinc and steel than can be achieved by any other method.

UNITED CONTINUOUS ELECTROLYTIC PLATING LINES in present daily operation are delivering consistently high quality tin and zinc plated strip at peak production with minimum interruptions for adjustments or maintenance.

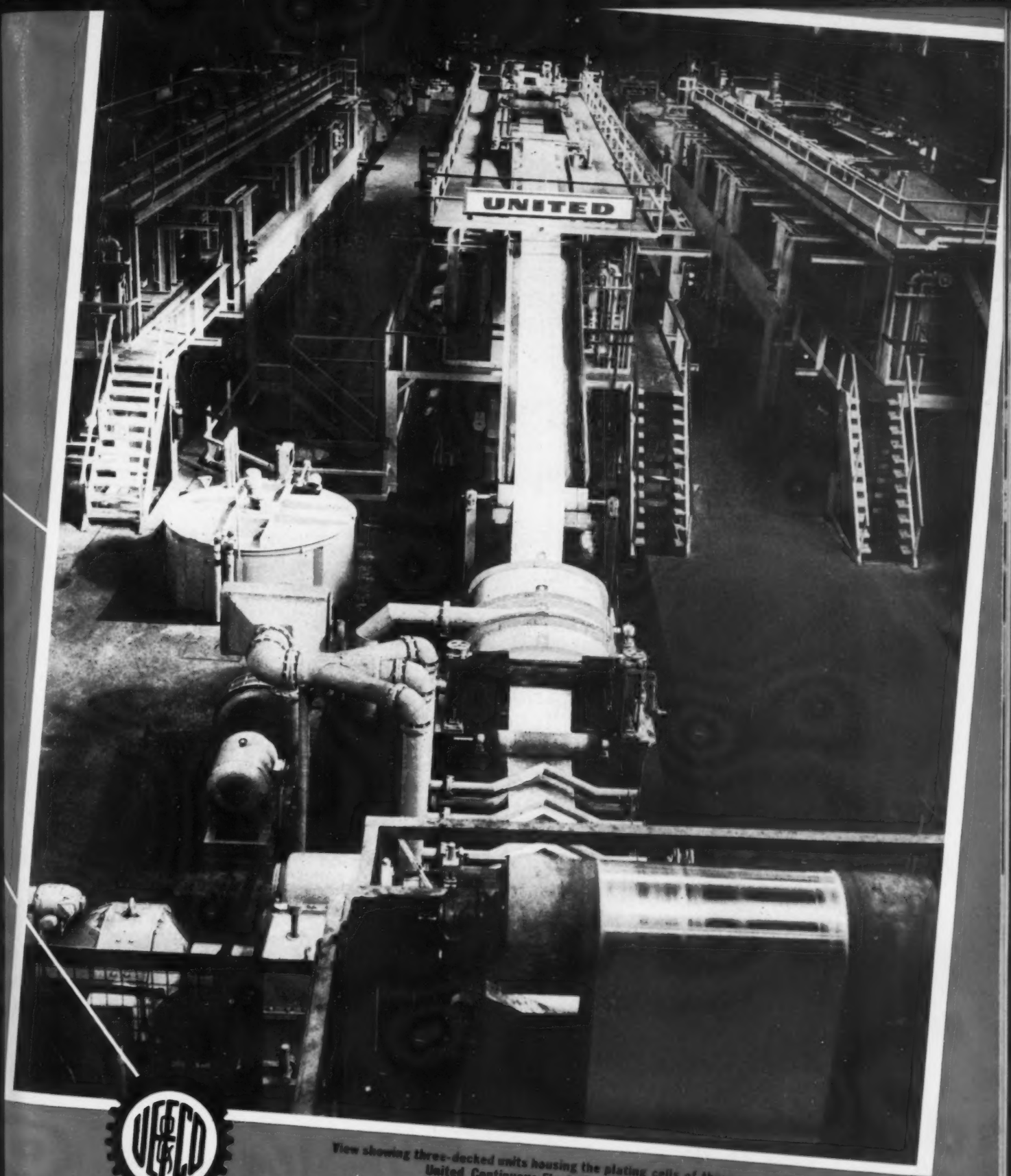
Installation *now* of a UNITED CONTINUOUS ELECTROLYTIC PLATING LINE in your plant may not only solve present vexing cost and production problems, but assure you definite competitive advantages in the post-war market.

Consult UNITED engineers for further information, recommendations and estimates.



in coated strip steel rising to top of electrical induction heater through which it descends to receive bright, shining surface.

Electrotinned steel strip in bright finish being removed at end of United Continuous Electrolytic Plating Line.



View showing three-decked units housing the plating cells of three separate United Continuous Electrolytic Plating Lines.

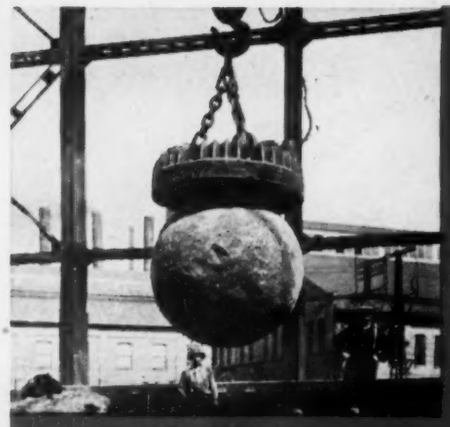
UNITED ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at PITTSBURGH · VANDERGRIFT · NEW CASTLE · YOUNGSTOWN · CANTON

Davy and United Engineering Company, Ltd., Sheffield, England
Dominion Engineering Works, Ltd., Montreal, P. Q. Canada

** The World's Largest Designers and Makers of Rolls and Rolling Mill Equipment*



No. 4 Type SA Lifting Magnet with a 12,000-lb. Skull Cracker Ball.

MAGNETS THAT MEASURE UP TO *Every* REQUIREMENT

Circular Magnets up to 65" diameter

IT is not the ordinary job but the extraordinary job that tests the mettle of a magnet—long hours of operation with frequent lifts, working at top speed and utmost capacity. On the unusual, as well as the average job, EC&M Magnets have proven themselves equal to every requirement.

They incorporate:

1. Automatic-discharge magnet controllers.
2. Ribbed magnet-case (high-radiating capacity).
3. Quickly adjustable controller to suit load, voltage, size of magnet, etc.
4. Power contactor of *Line-arc* design.

Ask for 18-page Bulletin 900AD.

THE ELECTRIC CONTROLLER & MFG. CO.
2698 East 79th Street **Cleveland 4, Ohio**

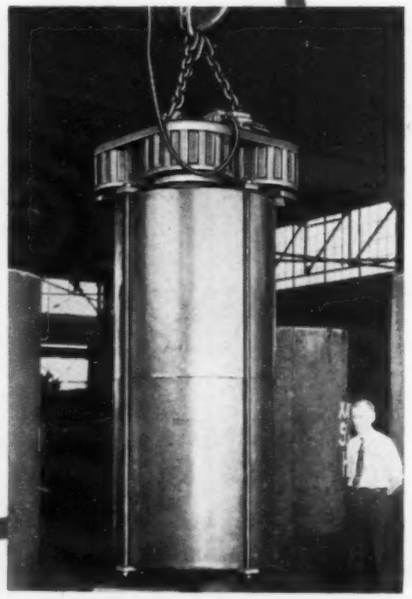
No. 3½ SA Magnet lifting buggy of wood to foundry charging floor level.

A big lift (5850 lbs.) of pig iron by a No. 6 EC&M Type SA Magnet.

Portable-truck, Gasoline Crane with 29" inch diam. Type R Lifting Magnet.

World's Biggest Lift of Coiled Steel

★ EC&M No. 6 Type CSM Magnet, on test, lifting a total load of 56,600 lbs. through two wooden spacers, making an air gap of $\frac{7}{16}$-inch between the magnet and its load. The load consists of 2 coils, each 55½ inches O.D. and 61 inches high, bolted together for the test and the lift was made with only 80% current flowing through the magnet and after the magnet had reached its normal working temperature. The normal rating of the No. 6 CSM Magnet is 40,000 lbs. and this test was made to show the high safety factor of this magnet for coil handling service.



It takes good oil— plus skillful treatment — to make

OIL WITH GUTS

Lubricants today have to stand up under a 24-hour-day bombardment. They are the shield between metal surfaces in motion, enabling machines to last longer, perform better, produce more.

To carry today's loads at high speeds, the lubricant cannot be just "any old oil". It should be prescribed by a lubrication specialist, and made by a concern which knows the secrets of modern petroleum reinforcement.

Houghton qualifies both ways—in the oil it self and in the counsel given to help establish sound lubrication practice.

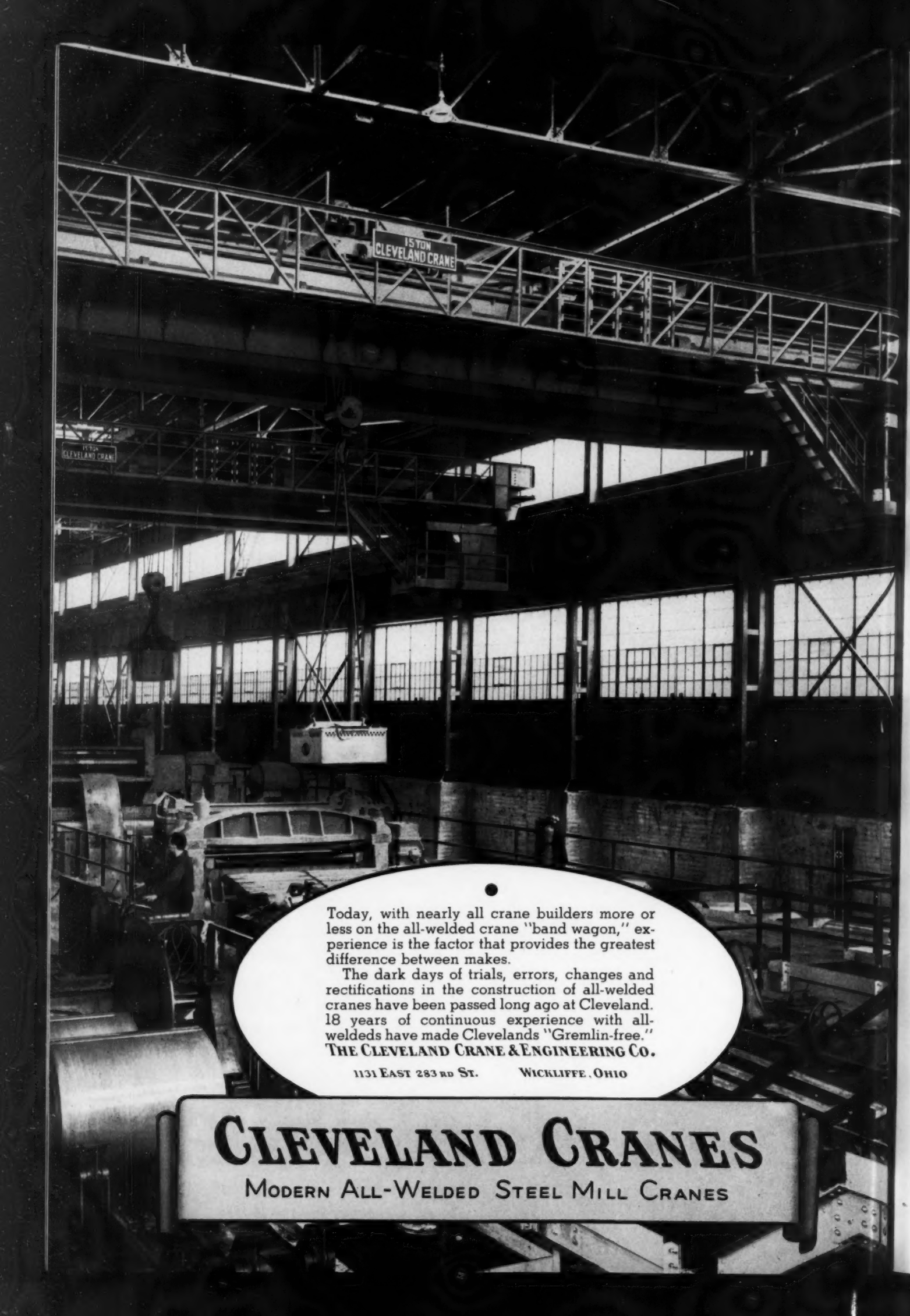
We start with the best selected stocks suited for the purpose, then treat those stocks to enable them to carry loads twice to four times as heavy as the same oils untreated. We treat them also to increase their resistance to leakage—better cohesion, and adhesion to metals. And there are other treatments to prevent sludging, to render them stable under severe conditions, without chemical change.

That's why we say that good oil plus skillful treatment means "oil with guts". Houghton's "fortified" oils are helping war production· may we demonstrate?

E. F. HOUGHTON & CO.

303 W. LEHIGH AVENUE, PHILADELPHIA

CHICAGO • DETROIT • SAN FRANCISCO • TORONTO



Today, with nearly all crane builders more or less on the all-welded crane "band wagon," experience is the factor that provides the greatest difference between makes.

The dark days of trials, errors, changes and rectifications in the construction of all-welded cranes have been passed long ago at Cleveland. 18 years of continuous experience with all-weldeds have made Clevelands "Gremlin-free."

THE CLEVELAND CRANE & ENGINEERING CO.

1131 EAST 283 RD ST. WICKLIFFE, OHIO

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

Crops *and* Shorts

REGARDLESS of dismal experience with artificial economics, a new plan always bobs up involving Uncle Sam in the old Santa Claus role. This time it is Phillip Murray calling for DPC agents to operate five blast furnaces (Republic at South Chicago, Inland, Pittsburgh Steel at Monessen, Lone Star in Texas, and Geneva) and sell pig iron to small companies below ceiling prices so as to enable them to meet competition from the larger low-cost producers. The list of companies to receive this subsidy includes 20 producers totaling 5,678,000 tons annual capacity and employing 27,175 workers. Inspection of the list of 20 companies presents a pretty problem in transportation in supplying them from the blast furnaces listed — particularly if the WPB Steel Division ruling against cross-hauling means anything. Incidentally, the higher steel wages rise, the more marked the differential between operating costs of the small plants and the large plants will become.

▲

CHECKING a little further into rumors mentioned last month concerning bidders for some of the new DPC plants, we find many of the alleged bidders profuse in their denials. Could it be that such rumors are merely a method of turning the heat on the builders, most of whom have first purchase options?

▲

ACCUMULATING pressure on WPB for the production of civilian goods as cut-backs occur and surpluses appear received reinforcement from the third annual Truman Committee report, and seems to be overcoming the original reluctance instigated by the armed forces. First evidence is some paper work dealing with flatiron production and indicating that the production quota will be split among manufacturers according to 1940 production, thus barring newcomers in the field.

▲

INCIDENTALLY, it was nice to see all the compliments to the production efforts of industry, labor and government in the Truman report, even if some of the bouquets did carry a pot with them.

▲

FIGURES released by the American Iron and Steel Institute show that, of the total of 59,760,000 tons of finished and semi-finished steel shipped during 1943, 14,158,000 tons went to lend-lease shipments and 11,433,000 tons to naval and merchant vessel builders. Will some statistician please figure out how many automobiles, refrigerators, bobby pins, etc., that would make, comes the time for civilian frivolities?

THE month of February saw 134 merchant vessels slide down the ways of shipyards in the United States, a total of 1,372,864 deadweight tons. Included in this total is the first of the Victory types and 18 long range type cargo ships. Also included are 77 ships of the Liberty type, recipient of considerable publicity recently as these vessels continue to crack open in service. It has been stated that about 60 Liberty ships have failed in service, some in stormy weather, some in calm water, some tied up at docks. At least three have broken in two pieces at sea, two being lost, and one towed into port in two sections. Shipmasters have stated that the design is weak longitudinally. Some testimony at investigations told of forcing plates together with screw jacks before welding. A Maritime Commission spokesman has said that the ships are better after cracked and repaired, as stresses are relieved. Sounds like a drastic method of relieving stresses.

▲

ESTIMATES by WPB of total requirements and supply of vital metals in 1944 continue to show deficits in carbon and alloy steels (1,202,000 tons and 868,000 tons, respectively). Lead also shows a slight deficit, while surpluses are indicated in copper, aluminum, magnesium and zinc.

▲

DISCOVERY of the fact that higher wages do not always mean higher net income is contributing to a seriously high labor turnover in many factories, particularly on the west coast. Homesickness and crowded living conditions also contribute. Some married women are quitting to keep house, and cut-back layoffs induce others to quit. At any rate, the "gold rush" is over, and it has been finally recognized that surplus labor in one industry or one location is of little help to shortage in another industry or location.

▲

BESIDE being easy on our gas and coal bills, the relatively open winter brings another advantage. Great Lakes shippers believe that full fleet operation may be possible early in April, two weeks or more earlier than last year. This would assure the movement of the desired 90,000,000 tons of iron ore down the lakes before navigation is suspended next fall.

▲

IT has been predicted that 600,000,000 tons of bituminous coal will be produced next year, against a requirement of 620,000,000 tons. This means that conservation must be carried to a high degree. Large consumers are also being advised to build up as large a stock as possible.

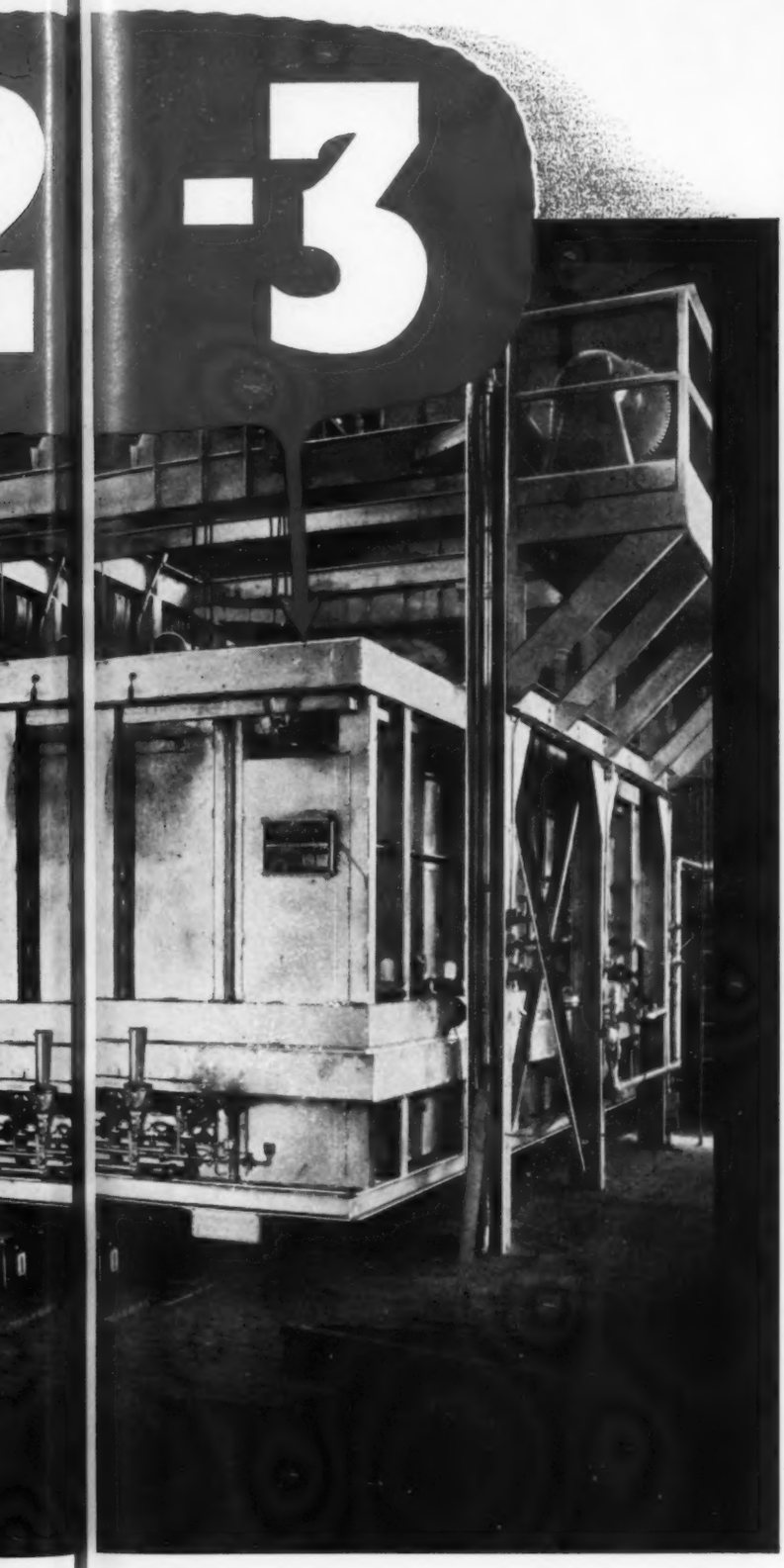
▲

ACCORDING to the Oil Heat Institute of America, world oil reserves are sufficient to last for 1000 years at peacetime rates of use. This would require additional reserves of about five times the present proved reserves.

▲

DURING the period from March 11, 1941, (the beginning of lend-lease) to January 1, 1944, the United States has sent to its allies 28,000 planes, three-fourths of which were of combat type. In addition, there was $1,600,000,000 worth of aircraft engines and parts. Our production in the same period totaled 150,000 planes.

1-2
STEEL MILL HEAT TREATS BAR STOCK
SPECIALLY DESIGNED SC RADIANT TUBE FURNACE UTILIZES SPECIAL ATMOSPHERES FOR ANNEALING WITHOUT DECARBURIZATION
SURFACE COMBUSTION



In 1942, Surface Combustion announced the installation of a special designed, radiant tube furnace, utilizing a special atmosphere for annealing of rods and bar stock of high carbon steels, without decarburization.

✻ Today...this installation has grown to three identical units.

This type of unit is unique as it combines features of flexibility and efficiency that makes them practical and desirable. Combined are the car-bottom and individual-lift-cover features that eliminate furnace doors for greater efficiency, and to provide ease in the handling of materials. The method of control that is employed makes certain that the gaseous atmosphere will be in equilibrium with the steel at all heating and cooling temperatures. All size stocks are annealed without scale or decarburization.

This installation is characteristic of Surface Combustion organization ability to design and build equipment to meet either roughing or finishing equipment needs.

The Heater's and Heat Treater's Helping Hand

'Surface'

SURFACE COMBUSTION • TOLEDO 1, OHIO

WHEREVER HEAT IS USED IN INDUSTRY
...FROM INGOT TO FINISHED PRODUCT

CONTINENTAL
Blooming Mill
MANIPULATORS

With complete facilities, and years of experience in engineering research as a background, Continental is equipped to build complete Mills as well as Machinery to your specifications . . . We invite your inquiry.

OPERATING FEATURES

1. Designed so that all operating mechanism is on one side of the table.
2. Finger operating shaft mounted on independent beam to eliminate binding of shaft due to warping of side guard.
3. Roller Bearing equipped throughout, including rack pinions and rack rollers for smoother operation.
4. Scale Free—No working parts are exposed to scale or grease.
5. Oil and Grease Free — All lubricating parts completely enclosed. Rack teeth totally sealed in enclosed case.
6. No Square Sliding Shafts or Differential Drives.
7. Both rack pinion shafts on same elevation.
8. Shallow pit for manipulators and drives.
9. All bearings lubricated by pressure grease system.
10. All gears and racks lubricated by pressure oil system.

BUY WAR BONDS!

Men are giving their lives—the least we can do is the most we can invest in war bonds.

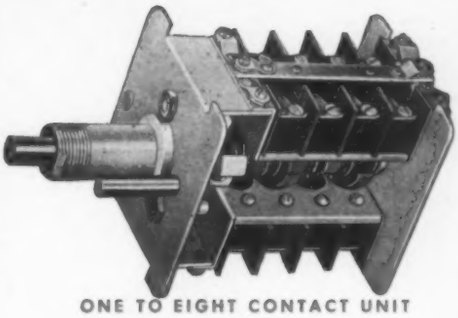
Continental Roll & Steel Foundry Company

CHICAGO • PITTSBURGH

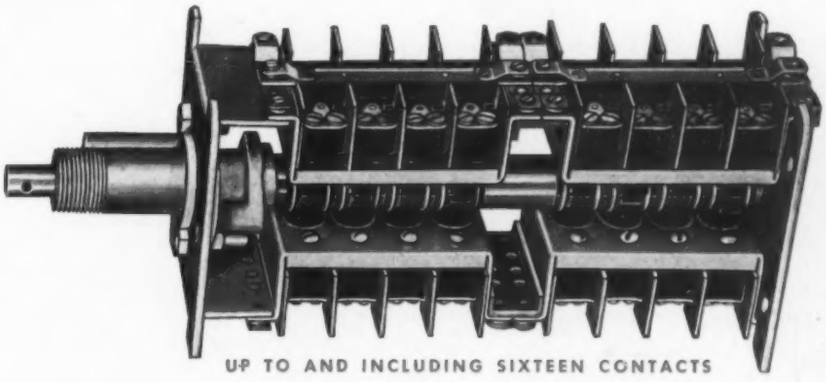
Manufacturers of Carbon and Alloy Steel Castings, Rolls, Rolling Mill Equipment, Mills and Special Machinery.

IT TRANSFERS MULTIPLE ELECTRIC CIRCUITS

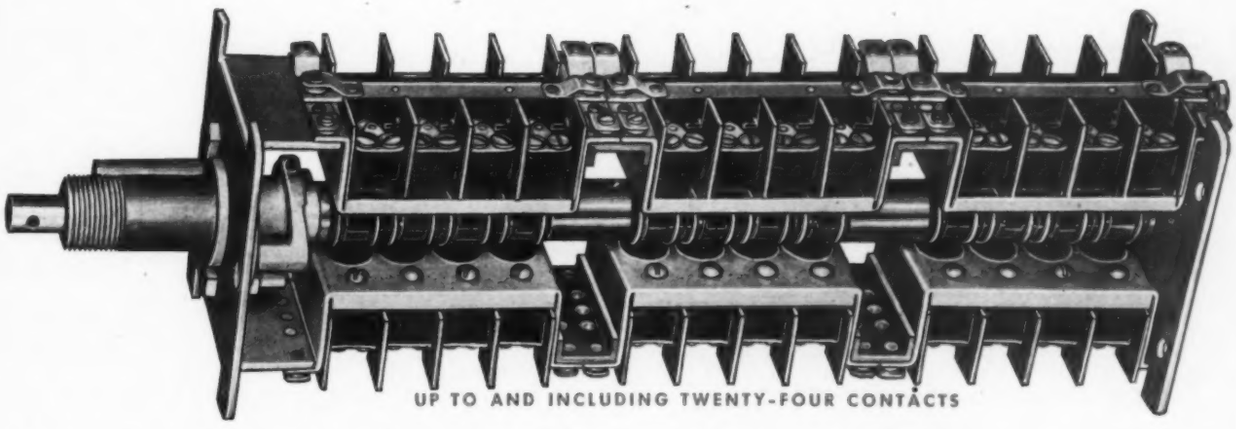
These "3C" Type SS selector switches are designed to transfer, simultaneously, multiple electric circuits, where not more than five positions nor twenty-four circuits are involved. ◆ Use as transfer switches on power presses, for instrument switching, float switch transfer, and general circuit setups, are typical applications. ◆ These switches are simple and sturdy in construction. All screws and springs in retaining bar are fixed in place to prevent loss.



ONE TO EIGHT CONTACT UNIT



UP TO AND INCLUDING SIXTEEN CONTACTS



UP TO AND INCLUDING TWENTY-FOUR CONTACTS

The shaft is carried in oil-impregnated bushings at both ends of the shaft. The cams are moulded Bakelite; almost limitless cam combinations are available.

Double break, silver-to-silver easily removable contacts are used. Three different types of operating handles—one with cylinder lock—are available.

ASK FOR FULLY DESCRIPTIVE BULLETIN 101, TYPE SS

OFFICES IN PRINCIPAL CITIES

THE CLARK CONTROLLER CO.

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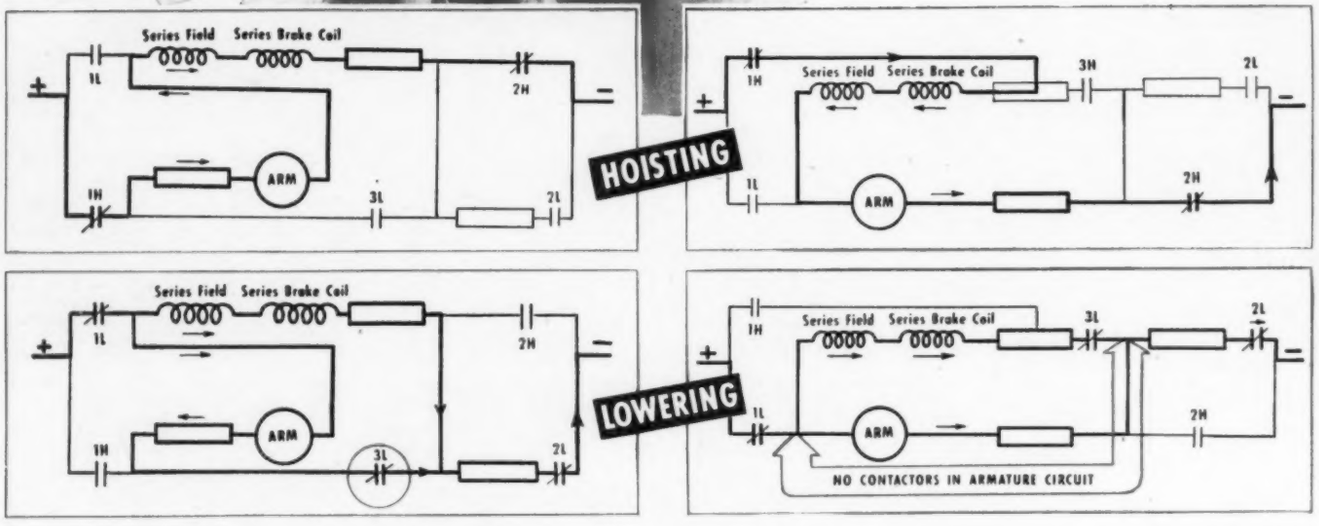
Safe Crane Control begins with the Circuit



CONVENTIONAL CONTROL

Conventional control circuits apply dynamic braking action when lowering, by reversing the armature. This necessitates the use of a contactor in the armature circuit. (See circled contactor "3L" in diagram.) Should this contactor fail to close the circuit for any reason, there would be no dynamic braking. The Magnetic brake is held released by a separate field circuit and there is nothing to keep the load from dropping.

WESTINGHOUSE PATENTED SAFETY CIRCUIT

Westinghouse Crane Control eliminates this possibility of failure because it reverses the *field*, doing away with the use of any contactors in the armature circuit. (See diagrams.) Since there is no contactor to open the armature circuit you always have braking control whenever the Magnetic brake is released. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N. J-21304

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

WESTINGHOUSE

D. C. CRANE CONTROL

ALLIANCE EQUIPMENT IN ACTION

125-TON 4-GIRDER CRANE WITH 30-TON AUXILIARY TROLLEY

The open hearth receives an extra shot of liquid vitamins in the form of hot metal from the mixer. The auxiliary hoist supplements the main hoist in draining the ladle.

A ladle full of hot metal can't be coddled. It has to be moved from the mixer to any point on the open hearth floor quickly, surely, and safely. That job hinges on the efficiency of your overhead crane.

For safety, every large Alliance hot metal crane has interlocking drums and a patented method of reeving. The four-girder construction of the bridge permits the passage of the auxiliary trolley underneath the main trolley. The one-piece steel trolley frames assure absolute alignment, ruggedness, and a minimum of maintenance. Anti-friction or our patented sealed sleeve bronze bearings keep all moving parts operating efficiently.

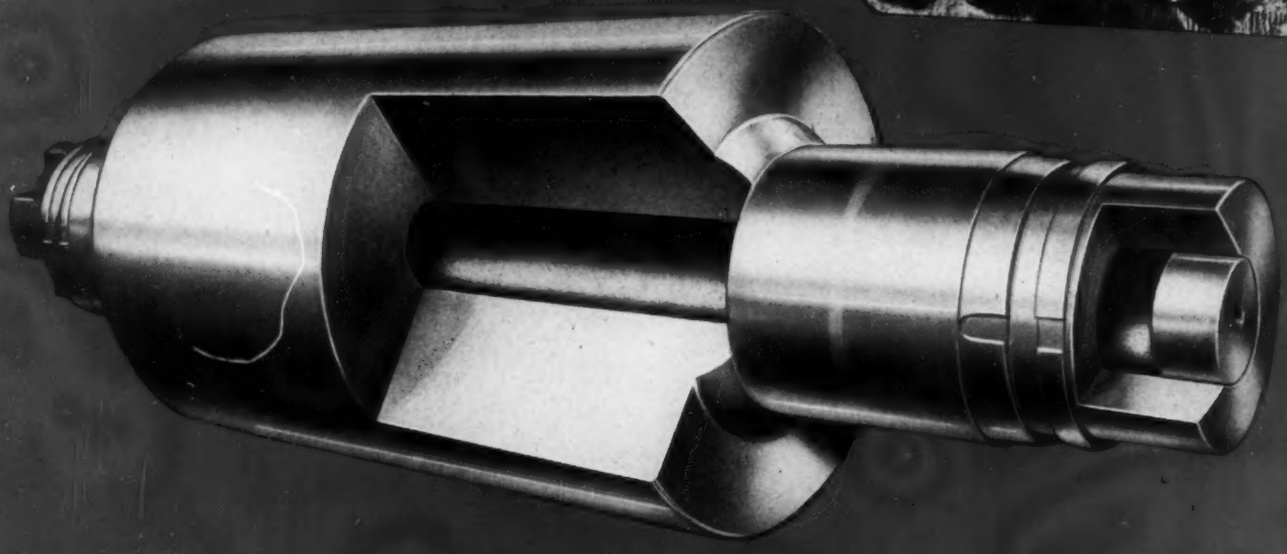
In 43 years of manufacturing cranes and other steel mill equipment, Alliance has developed and introduced many of the mechanical features which today are considered conventional.

LADLE CRANES . GANTRY CRANES . FORGING MANIPULATORS SOAKING PIT CRANES . STRIPPER CRANES . SLAB AND BILLET CHARGING MACHINES . OPEN HEARTH CHARGING MACHINES

Alliance

THE ALLIANCE MACHINE CO., ALLIANCE, OHIO - SPECIAL AND STANDARD CRANES FOR HEAVY DUTY

OHIO ROLLS—"BEARS FOR PUNISHMENT"



HOLL-O-CAST STEEL ROLLS

have more strength and hardness

because they're heat treated

inside and out

These Rolls are cast with a hole through the center.
Rolls cast in this manner have four big advantages:

1. Reduction of ingotism.
2. Positive elimination of internal hot rupture.
3. Stronger resistance to fatigue in the necks.
4. Improvement in heat treating process.

The balanced alloy steel in Ohio HOLL-O-CAST Steel Rolls is selected for strength—and much greater strength is attainable through this special heat treatment than by analysis alone.

SELECT FROM ANY OF THESE 9 TYPES OF OHIO STEEL AND IRON ROLLS:

Carbon Steel Rolls
Ohioloy Rolls
Ohioloy "K" Rolls
HOLL-O-CAST Rolls
Chilled Iron Rolls
Denso Iron Rolls
Nickel Grain Rolls
Hi-nickel Grain Rolls
Flintuff Rolls

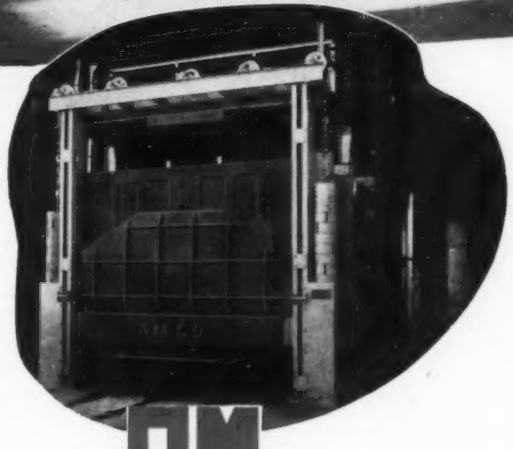
THE OHIO STEEL FOUNDRY COMPANY
LIMA AND SPRINGFIELD, OHIO
ENGINEERS • FOUNDERS • MACHINISTS

OHIO ROLLS

FREE ENTERPRISE IS THE ONLY WAY TO CONSTANTLY HIGHER AMERICAN LIVING STANDARDS

AMCO

CAR TYPE FURNACES



AMCO Car-Type Furnaces are built not only for the emergency, but for many years of commercial production thereafter . . . *It pays to buy the best!*

The **AMSLER-MORTON** *Company*

FULTON BUILDING · PITTSBURGH, PA.

BONNOT-LENTZ BILLETEERS

HAVE BEEN ADOPTED BY BOTH BIG AND LITTLE STEEL FOR BILLET CONDITIONING

● The BONNOT-LENTZ Billeteer feeds clean billets into mill schedules faster, at lower costs and man hours than by any other method.

WRITE US FOR COMPLETE FACTS

THE BONNOT COMPANY
CANTON
OHIO

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ENGINEERED FOR IMPROVED PRODUCTION

Another 10% for Mr. Longfellow

. . . and many extra miles of wire rod!

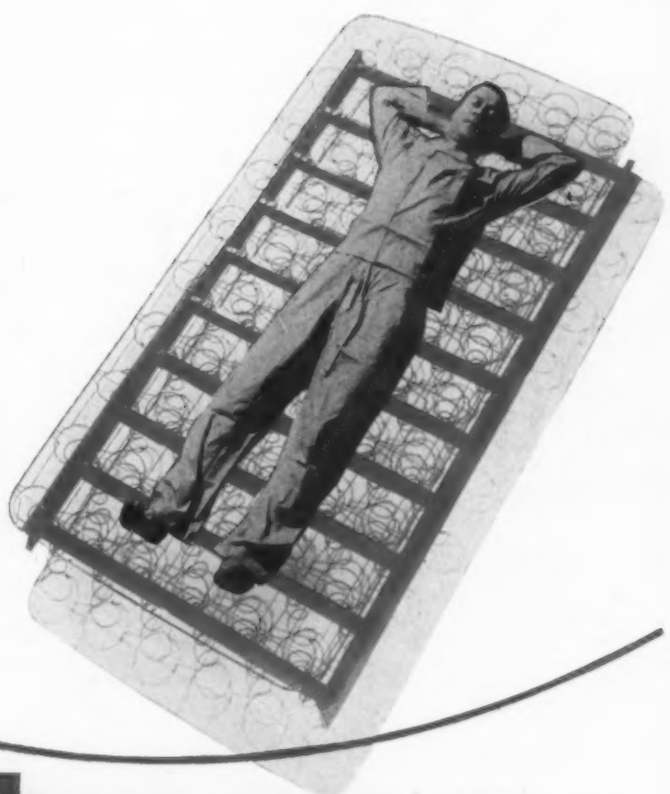
We *long fellows* may never realize the 7-foot bed spring! But in any event, the post-war demand for prewar products promises a new prosperity based upon *more* tonnage, *greater* accuracy, *lower* costs.

Even a bed spring can be produced better, faster and cheaper if the cold drawn spring wire starts with a wire rod that is uniform in size and quality.

Plan with Morgan now for higher tonnage at lower costs . . . for the retooling and rebuilding of war-worn mills . . . for the installation of that new, improved Morgan Continuous Rolling Mill for rod, skelp and merchant shapes . . . or the new Continuous Wire Drawing Machines.

MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS

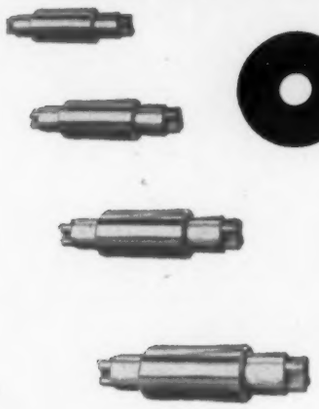
R-120



***PLAN NOW WITH* MORGAN**

ENGINEERS AND BUILDERS OF ROLLING MILLS . . .
WIRE MILLS . . . REGENERATIVE FURNACE CONTROL

AN "X" NUMBER OF ROLLS



All ground to the same degree of ACCURACY AND FINISH

Twenty years ago Farrel pioneered the development of the heavy duty type of roll grinding machine, equipped with the first successful crowning and concaving device. The roll turner's skill was *transferred to the machine,* making it possible for plant managements to fix and maintain definite standards of accuracy and finish.

Time has shown that Farrel Roll Grinders retain their *skill* over an indefinite number of years. (Just how many is anybody's guess at the present time—early machines are still grinding rolls with speed and precision.)

Besides the durability and long life built into them, Farrel Roll Grinders also have a number of improved features of design which greatly increase the convenience and efficiency of operation, assure uniform precision and superior finish, and increase the output of finished rolls.

Write for complete information. Ask for a copy of Bulletin No. 111.

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Farrel Heavy Duty Roll Grinders are built in six sizes to take maximum diameters of 24", 28", 36", 44", 50" and 60".
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WHEN YOU DECIDE ON REPLACEMENTS

Peace will come some day and then you'll want the lowest possible operating and maintenance costs.

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GEARS . . . PINIONS . . . ROLLS WHEELS . . . AND OTHER HARDENED PRODUCTS

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"Tool Steel" long life and savings are guaranteed.

THE TOOL STEEL GEAR & PINION COMPANY

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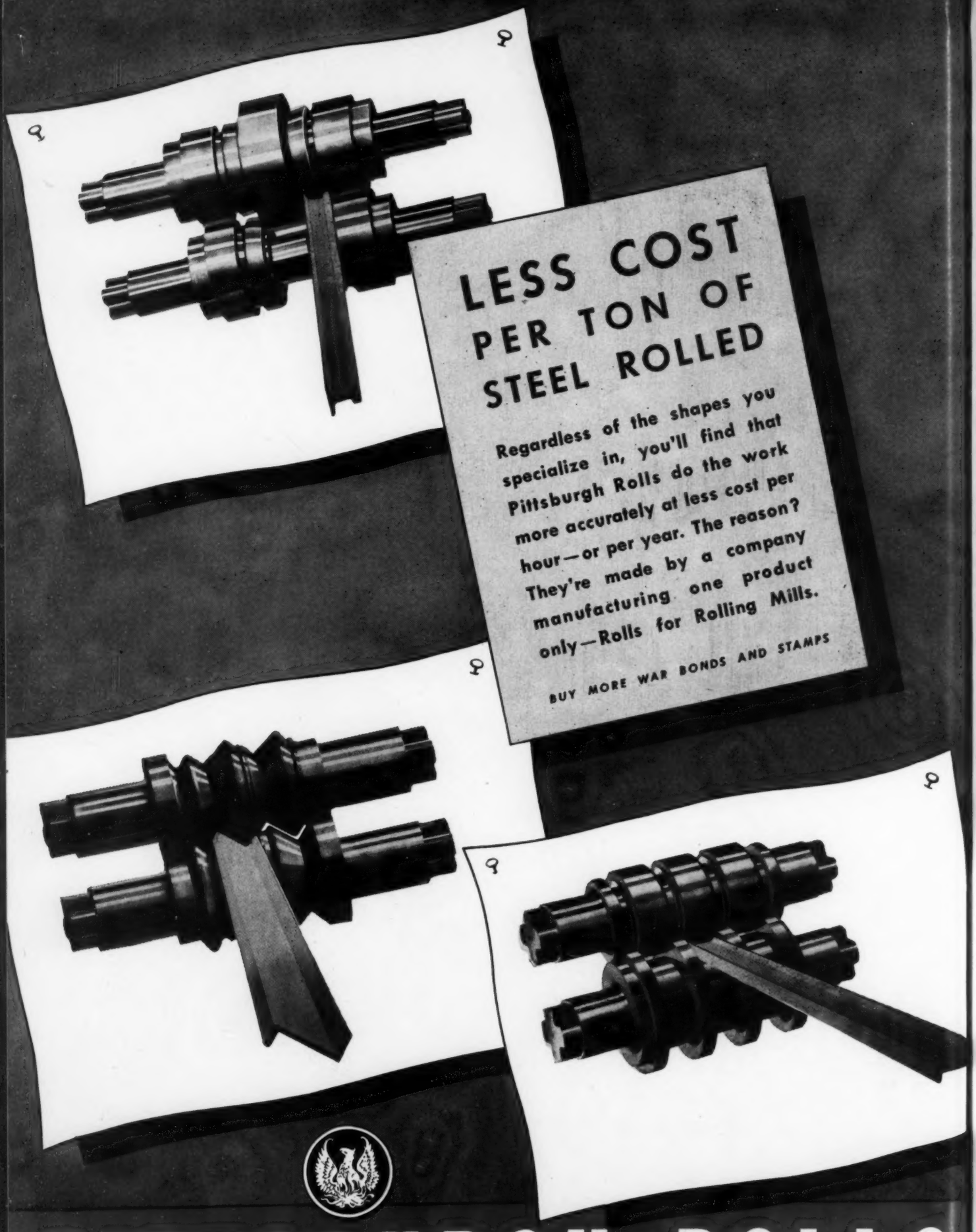

LESS COST PER TON OF STEEL ROLLED

Regardless of the shapes you specialize in, you'll find that Pittsburgh Rolls do the work more accurately at less cost per hour—or per year. The reason? They're made by a company manufacturing one product only—Rolls for Rolling Mills.

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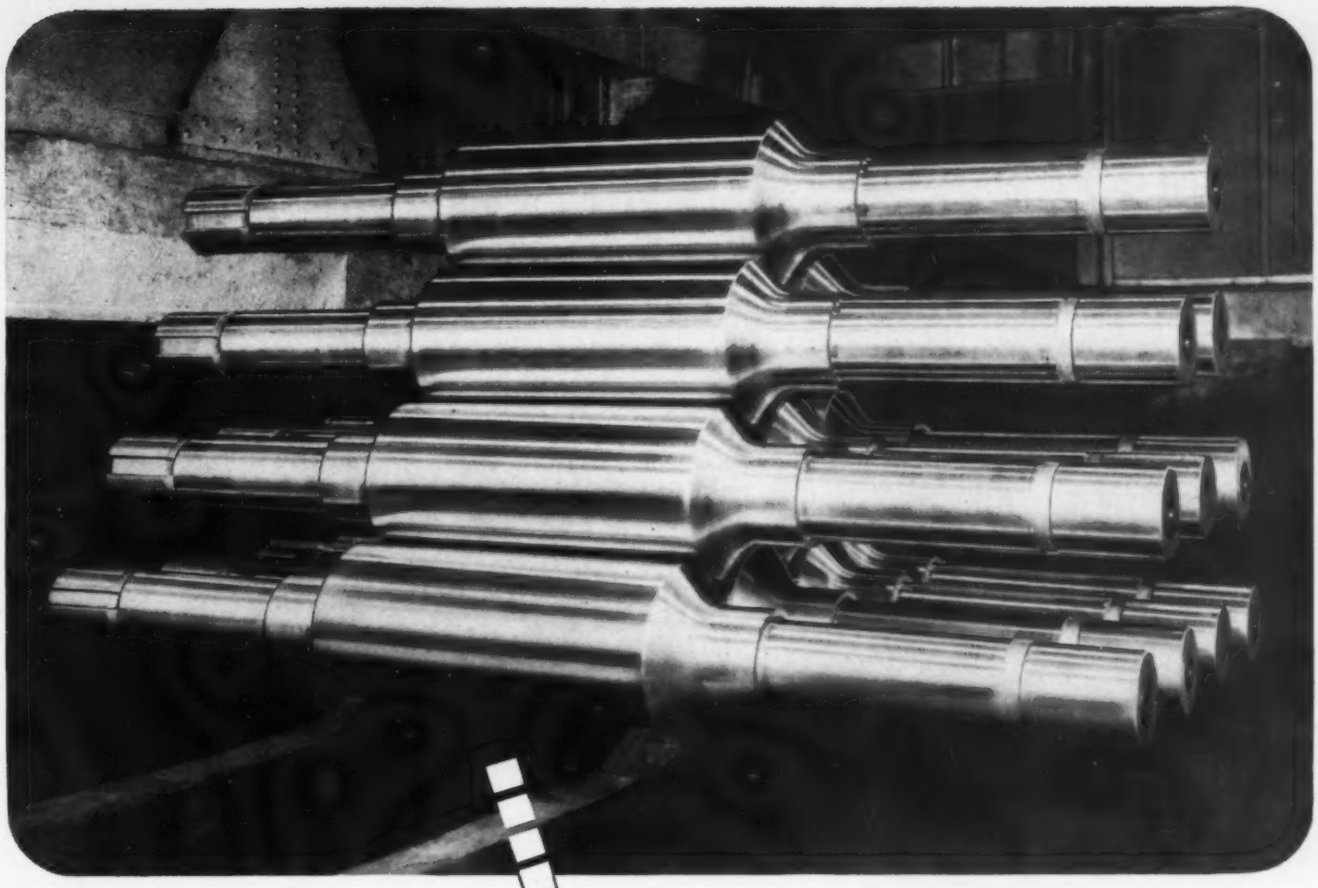
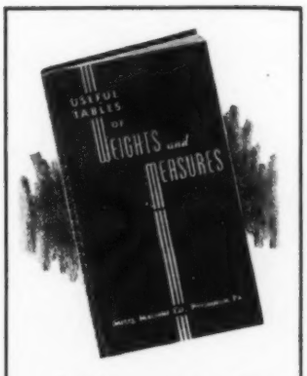
PITTSBURGH ROLLS DIVISION of BLAW-KNOX CO.—"Steel's Partner" • PITTSBURGH, PA.



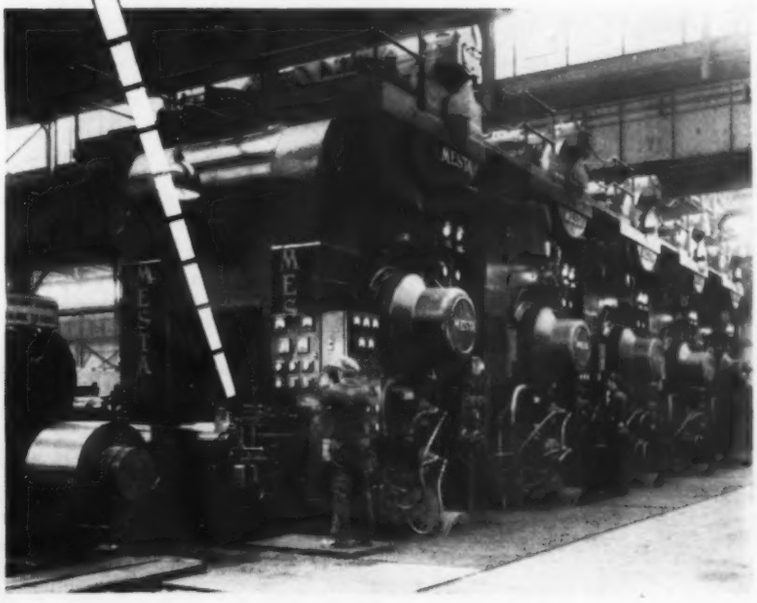
MESTA Forged Hardened Steel Working ROLLS



Send for your copy of this 64 page booklet containing valuable engineering data. Address your requests to Dept. A-3.

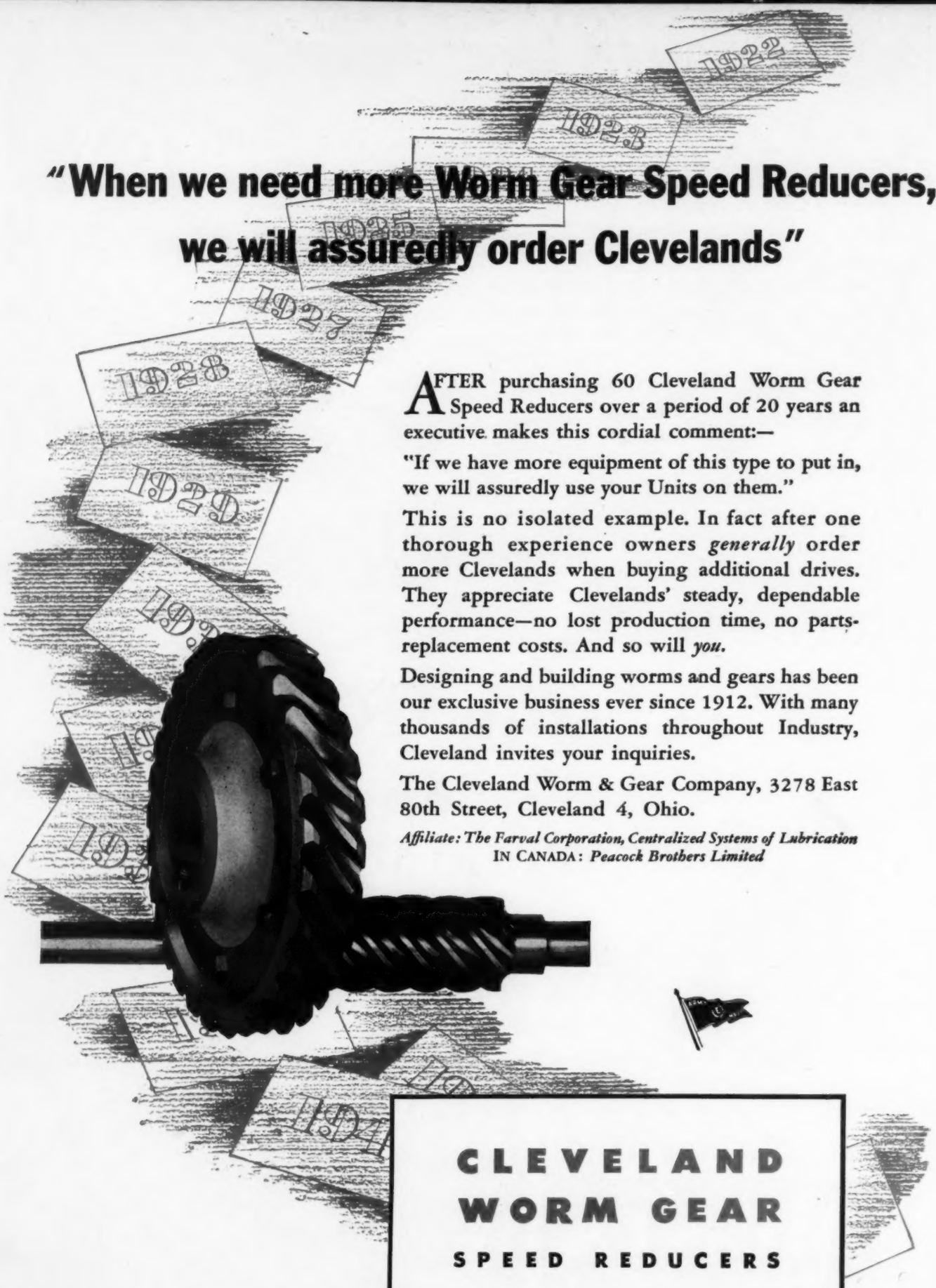
The Army-Navy "E" Flag with four stars, flies over the Mesta plant

BUY WAR BONDS



MESTA
MACHINE COMPANY
PITTSBURGH, PA.

"When we need more Worm Gear Speed Reducers, we will assuredly order Clevelands"



AFTER purchasing 60 Cleveland Worm Gear Speed Reducers over a period of 20 years an executive makes this cordial comment:—

"If we have more equipment of this type to put in, we will assuredly use your Units on them."

This is no isolated example. In fact after one thorough experience owners *generally* order more Clevelands when buying additional drives. They appreciate Clevelands' steady, dependable performance—no lost production time, no parts-replacement costs. And so will *you.*

Designing and building worms and gears has been our exclusive business ever since 1912. With many thousands of installations throughout Industry, Cleveland invites your inquiries.

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**United States Army.*

Iron and Steel ENGINEER

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☛ That means that with Excitron there are no ignition impulses to be synchronized with main anode voltage. Tubes don't require re-ignition at start of each positive half-cycle.

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A 1699

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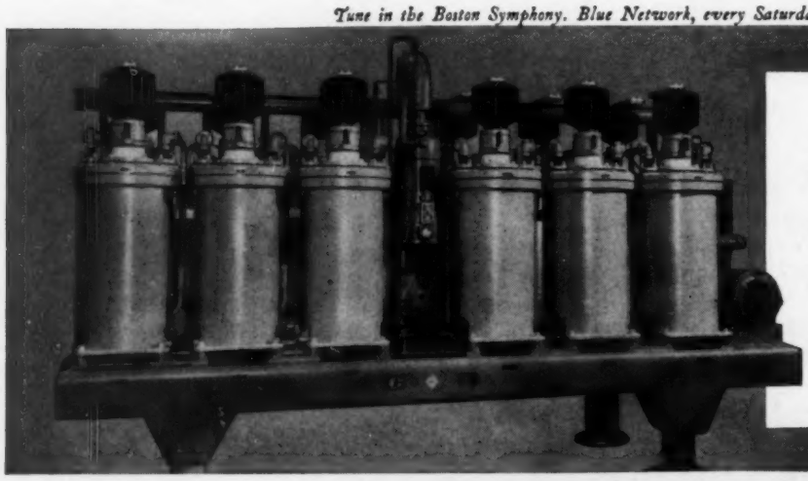

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LUBRICATION OF

Non-Metallic Bearings

. . . . grease lubrication, with water as a coolant, is advantageous on low speed, high pressure installations . . . . some plants apply grease only before shutting down the equipment . . . .

by G. E. Reiser
ASSISTANT LUBRICATION ENGINEER
BETHLEHEM STEEL COMPANY
LACKAWANNA, NEW YORK

▲ THE art of manufacturing bearings of the phenolic type, has been broadened with the passing of each year, and their use has gradually been extended from their first installations on light loads at relatively high speeds, to heavy loads and moderate speeds. The quality has also been improved to the point where they are adaptable for most conditions in present day applications, and after more than ten years of extensive use, synthetic bearings have now become definitely established in steel mills. Because their characteristics are entirely different from those bearings of the metallic type, it is necessary for operating men to become familiar with a few simple requirements before they can use them successfully. This discussion, composed of excerpts from previous papers, conveys experiences and other information which should promote a better understanding of the lubrication of composition bearings.

All bearings, whether metallic or composition, are limited in performance by the maximum allowable temperature of the material. All bearings generate frictional heat, the control of which will spell success or failure in any application. Friction is the result of surface contact and is governed by the relative smoothness and hardness of the surfaces involved. The roll neck or journal should be smooth and free from scratches and pits. Where heavy bearing loads are encountered, the finishing of the necks must be done very carefully, because this is one of the important factors in synthetic bearing operation. Good chuck fit is next in importance, and the chucks and the bearings should therefore be machined to a good fit. When the contours of chucks and bearing liners are not in perfect agreement, hot spots will develop due to the concentration of the load,

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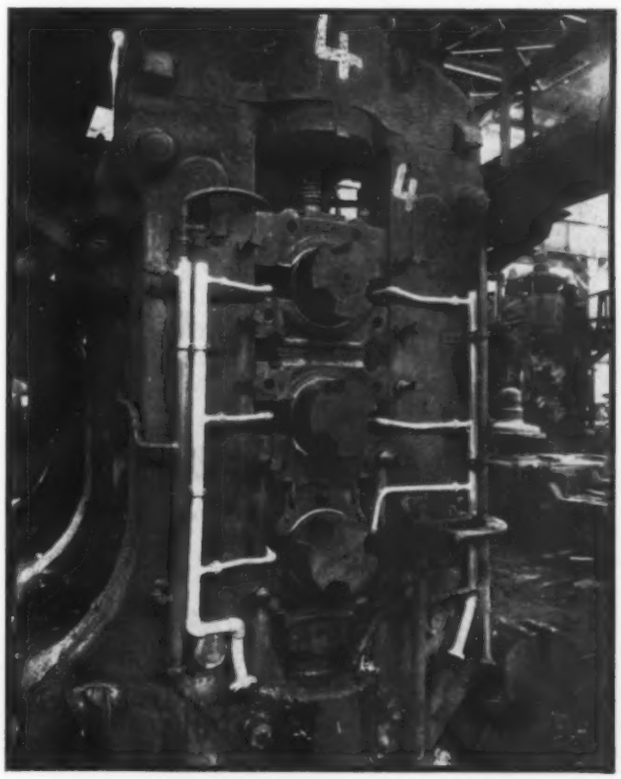
Figure 1 — Installation of synthetic bearings, showing spray arrangement.



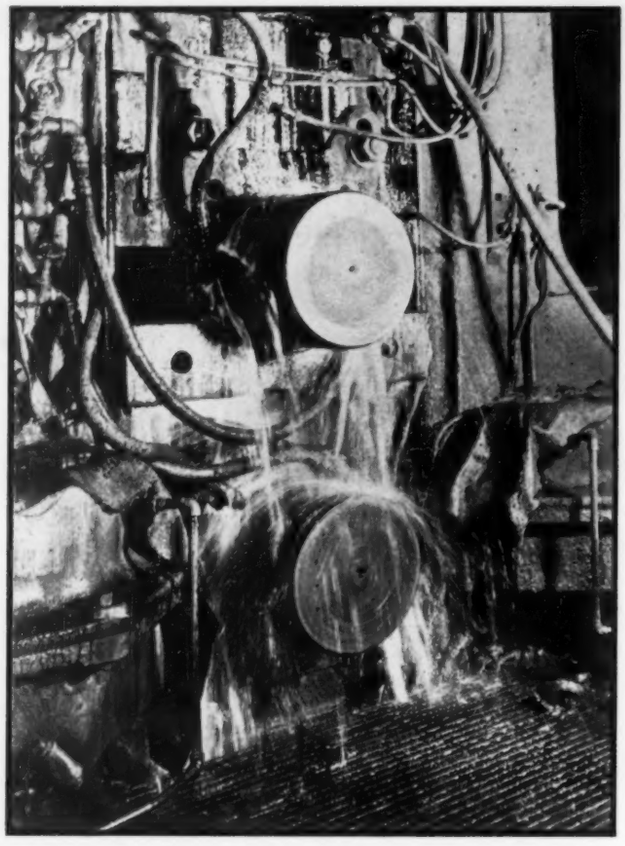


Figure 2 — Bearings and journals of a 32 in. mill, well drenched with water.

Figure 3 — Top bearing on 54 in. blooming mill, showing large grease parts and water sprays.

and failure is likely to occur if the condition is not corrected. Assuming that all bearing liners have a perfect backing in a chuck strong enough to resist bending strains, the contact area is the next consideration.

Regardless of make-up, bearings of the phenolic type have a fine resin film on the surface which is hard and slightly abrasive in action. This increases the operating temperature in the running-in period and calls for extra care for the first few hours of operation. Going even further, a bearing may have a perfect chuck fit, roll neck in excellent condition, skin removed from the bearing surface, and still operate hot. This behavior can be caused by too large an arc of contact for the bearing. Our experience is, an arc of contact over 120 degrees is not desirable for synthetic bearings due to the resiliency of the material which, under heavy loads, will spring in and produce a choking effect on roll neck or journal. For light bearing loads this behavior need not be considered. In some designs attempts are being made to eliminate this clamping by using a bearing with an inside diameter up to $\frac{1}{16}$ inch larger than the outside diameter of the roll neck. This is occasionally worse than the clamping effect itself, because, if the load is not sufficient to compress and cold-flow the material to the form of the roll neck, a heavy load concentration will take place, resulting in hot spots and eventual wiping of the bearing. Bearings that are jaw tight due to changing from roll to roll of different journal diameters will squeal and burn when the mill is first started. Swabbing of bearings and journals in roll changes will prevent this. Thrust collars are bound to wear excessively regardless of lubrication, if they don't fit perfectly into the fillet. If the collar has too small a radius, it will climb the fillet, causing spotty contact and burning. Lubrication at its best cannot rectify such a condition. After a mill has been set up, rolls and bearings changed and pulled up tight, it is always good practice to back off the thrust adjustment screws a flat or two. This relieves the collar sufficiently to allow water to penetrate and lubricate. With synthetic resin bearings, the arc of contact should be just large enough to maintain proper roll alignment, that is, it may be much smaller than for metal bearings. Under light loading, danger from hot spots is not serious. The proper contact area is gradually established in operation, at a point where wear is at a minimum.

As more experience is being gained in operating these bearings, it becomes easier to suggest workable ideas in regard to the arrangements of scale guards, water guards, wipers and other devices that are needed on many installations. Scale guards are necessary on plate mills, blooming mills and other large stands. Different types of guards are used, depending upon whether hot top ingots are rolled, or only the usual quantity of heavy mill scale is encountered. Water guards have been developed which effectively keep water off dry rolling stands. Pinion stands are equipped with still a different type of guard, easily installed on open-type housings.

So far we have considered the reduction of frictional heat by providing perfect surfaces and bearing fits. However, due to the low heat conductivity of composition bearings, a cooling medium is required for regulating their operating temperature. Knowing the critical temperature and the rate of heat generation, the problem is to determine the rate of cooling which will permit operation below this temperature. Cooling of roll necks or journals is generally accomplished by the use of water. The amount of water required for this purpose is dependent on several factors.

(a) The heat generated in the bearing itself.
(b) The type of work, whether continuous or intermittent, with light or no load periods.
(c) The amount of heat transmitted from the roll body.
(d) The temperature of the cooling water, its location, and the exposed roll-neck area.

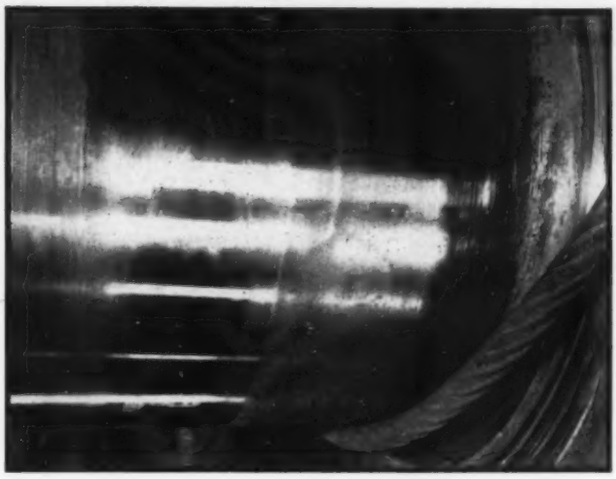


Figure 4 — Roll neck from 54 in. blooming mill, showing grease pattern and burnished surface on wiped section.

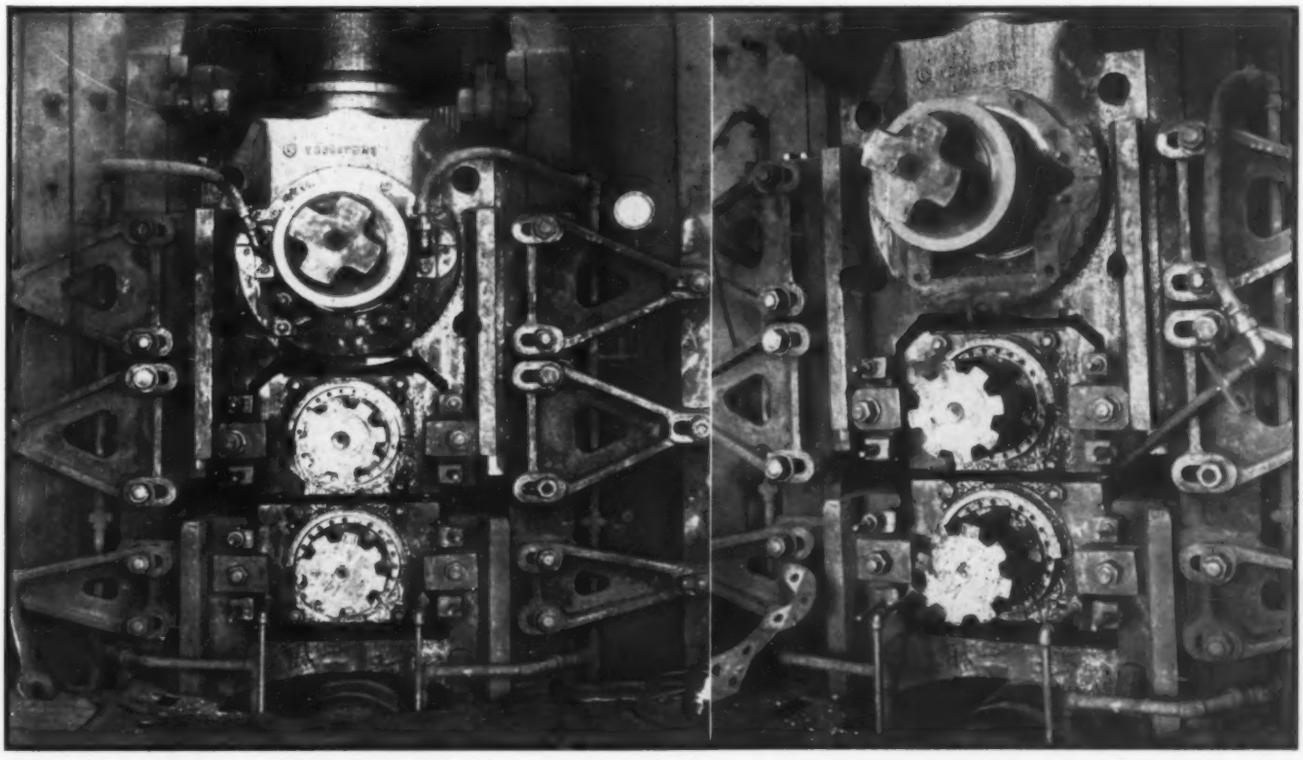
An easy flow of water, with ample volume, is usually more effective than a jet-type pressure spray. The water should cover as much of the exposed journal surface as possible. When bearings cover the top and bottom of the journal the water should be applied to both sides between the top and bottom bearings.

A lazy flow of water of good volume washes out the pepper carbon scale and also has a more definite cooling action than a spray. Sprays do not cool as efficiently as the swiftly flowing water will not allow heat transfer readily. Hydraulic sprays are detrimental insofar as they blow the pepper carbon into the bearings. Descaling sprays should always be set away from the mill.

Several precautions must be taken in connection with the water used. First, its temperature is a factor in the rate of heat transfer; second, it must be free from abrasive impurities such as dirt, sand, etc.; and third, it must be free from chemical impurities such as salt. When there is a trace of salt or acid in the cooling water, a surface breakdown of the roll neck is sure to follow, resulting in abnormal wear on the bearing. On the other hand, water in a closed system may be treated to give increased bearing lift. It is not the intention here to enter into the theories and facts behind the last statement. However, it is observed almost daily that under certain load, speed, temperature and water conditions a dark film forms on the journal or the neck surface and that, as soon as this film is in evidence, a reduction in power consumption and a drop in operation temperature follow. The formation of this film is partly due to chemical and partly to mechanical causes. The important fact is, however, that the separation of the bearing surfaces by this film results in a higher efficiency in operation.

This phenomenon prompted the investigation of lubricants as a means of producing a separating film between the rubbing surfaces. Water-soluble oils at once showed their inability to maintain a separating film even under moderate load conditions. The same was noticed for most of the water-repellent oils investigated. The reason for this is the inability of the oil to adhere to the rubbing surfaces. Some of the high-pressure greases operated satisfactorily at speeds of 200-250 fpm and medium loads up to 1750 psi, but failed badly at low speed on high bearing pressure applications. The final investigation was made with extreme pressure quality greases, and here compounds containing tallow or suet proved superior to most other types of extreme pressure media.

Figure 5 — Four-high mill, showing special enclosed spray pipes in place and removed.



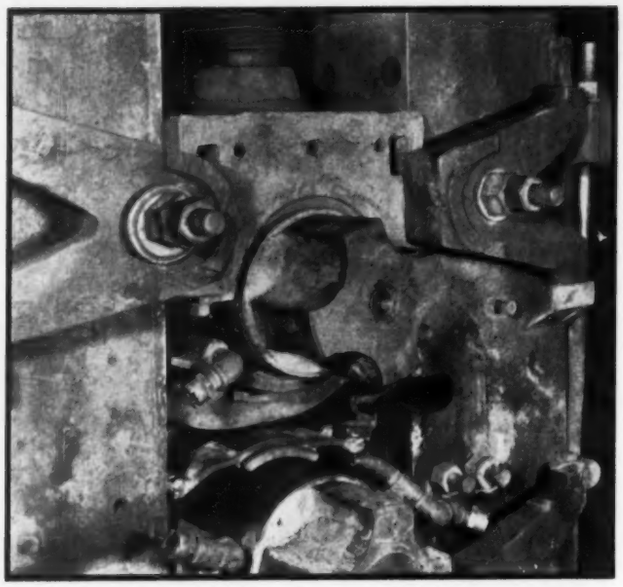


Figure 6 — View showing two types of sprays, one spotted on rider bearing and others covering full length of journals.

We now use grease containing graphite, which we contend "conditions" both the neck and the bearing. The graphite works into the pores of the steel to give it a burnished appearance. After the resin coating is worn away from the bearing surface, the graphite is held in the fabric to give added lubrication. This has been observed time and again after the change of rolls. When the top bearing is raised off the neck, a perfect pattern of the fabric is molded in graphite on the neck. It has also been found that as long as the roll is in storage, a very small amount of rust is found, showing the protective action of the graphite.

Tests on lubricants proved the importance of water cooling to maintain a reasonable operating temperature, as it was noticed that, with the exception of the self-generated dark film referred to, all other grease films gave a higher coefficient of friction. The friction was dependent on the lubricant used and not on the type of the synthetic bearing. Where speed and load conditions do not encourage lubrication of synthetic bearings with water only, the addition of the proper type of grease will permit satisfactory operation and increase bearing life. Each bearing has its own characteristics and a lubricant satisfactory for one will not necessarily do for another. Some experimentation may be required on each application as well as on the different makes of synthetic bearings to select the lubricant best suited for the work. First, a grease should have a film strength in excess of the highest bearing pressure possible in the particular case; it must adhere to the roll neck and resist the wiping action produced under load; it must not be soluble, and it must have a high melting point. It should also be kept in mind that a fine film of grease is much to be preferred to a heavy coating of lubricant. With these points in mind the search for a lubricant is a minor problem and the benefits received will shortly compensate for the small amount of work involved.

Automatic grease systems have proved very satisfactory, especially in blooming mills. A small shot of grease to a bearing, administered periodically, retains a film and maintains economical lubrication. Grooving of fabric bearings is not essential. We have found that a heavy chamfered grease entry port is all that is necessary. This forms a pocket from which the grease spreads effectively.

With proper lubrication and fitting of non-metallic bearings, a saving as high as 35 per cent in power has been realized. To achieve this saving the following suggestions are presented:

1. Roll necks or journals should be polished smooth, free from checks and pits.
2. Chucks or bearing housings should be strong enough to resist the maximum bending force possible on the unit and to fit bearings to a point of suction.
3. Synthetic bearings should be a heavy-weight fabric.
4. Arc of contact of bearing should be just large enough to maintain roll alignment.
5. Cooling water should be adequate to remove all heat generated in operation and should be free from abrasive and chemical impurities.
6. Grease lubrication, with water as a coolant, is advantageous on all low-speed, high-pressure installations. The grease film should be capable of resisting rupture even under maximum pressure.

DISCUSSION

PRESENTED BY

C. C. PECU, Lubrication Engineer, Bethlehem Steel Company, Lackawanna, New York

G. E. REISER, Assistant Lubrication Engineer, Bethlehem Steel Company, Lackawanna, New York

R. S. SHOEMAKER, Lubrication Engineer, American Rolling Mill Company, Middletown, Ohio

C. R. HAND, Lubrication Engineer, Bethlehem Steel Company, Sparrows Point, Maryland

C. E. PRITCHARD, Lubrication Engineer, Republic Steel Corporation, Cleveland, Ohio

J. L. McDERMOTT, Glyco Ryertex Division, Joseph T. Ryerson and Son, Inc., Chicago, Illinois

F. W. VOGT, Ryertex Division, Joseph T. Ryerson and Son, Inc., Jersey City, New Jersey

C. E. S. EDDIE, Lubrication Engineer, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan

C. C. PECU: The forerunner of synthetic bearings were those made out of lignum vitae wood. We, at the Lackawanna plant, were one of the first to use wood. It did very well, but on thin sections of sheet bar, wood being very resilient, the bar section was more or less off gauge. Consequently, when the synthetic bearing came into use we put it in the finishing stand, and due to its density, the section became even. Today on the 21 in. mill we have four out of the six stands using

wood bearings, mainly due to the very low cost of these bearings.

We use synthetic bearings in our 8 in., 10 in., 12 in., and 14 in. bar mills, also on the top of the 54 in. bloomer. We tried synthetic bearings on the 28 in. mill, but due to the end thrust of certain piling sections we had to discontinue their use.

We may not get the long tonnage life that some other plants obtain but our results are very satisfactory.

We find that the life of synthetic bearings are longest when the roll changes are few. We find that if we use a small neck, then change to a larger neck, that the bearing is jaw tight and the neck must wear the bearing rapidly until it has a proper fit in the bearing. This has been vividly demonstrated on our 54 in. bloomer, where as many as three roll changes were made in 24 hours. Whenever a bearing is jaw tight the bearing begins to squeal and smoke soon rises. The remedy is to swab as soon as possible with oil or grease. To overcome this trouble, we have grease pumped automatically to the 54 in. and 21 in. bearings.

We would like to get longer life on all our mills, but are doing very well. The present tonnage on the top roll necks of our 54 in. bloomer is over 1,000,000 tons. To deviate from synthetic to metal bearings, we have over 1,000,000 tons on the present metal bearings in our 54 in. bloomer.

Some of the troubles in using synthetic bearings are as follows:

We cannot use synthetic collars on our continuous 6 stand 10 in. mill due to the heavy thrust on the collar. We have in use twister boxes; due to the housings being close together, the box projects too near the next roll and some of the twist is taken up in the roll pass of the advance housing. If we had room for roller twisters we would not have this trouble. Again, on the three-high stands of our 12 in. mill, due to the looseness of the middle bearing, it not being lined up rigidly, we have not been able to get proper life.

Again, on our 44 in. bloomer, we were not able to get any life on the top collars due to the fact that when the roll is lowered the coupling end of the roll followed the spindle down faster than the free end of the roll, causing the collar to jam the corner of the window plate, forcing the collar off the bearing body, this misalignment being caused by improper spindle supports. This trouble has been eliminated on 54 in. by adding a hydraulic lifting cylinder to the supports of the spindle. Not only did this correct the bearing trouble, but added several hundred per cent to the life of the mill screw nuts.

Again, wherever the distance between the pinion and mill housing is close, and you are using an old set of rolls, causing the spindle to run on an angle, we find the coupling boxes to occasionally wear to such a point that spindles and couplings partially lock, throwing the roll off center. The above causes a heavy friction on the bearing.

Not only should all try to use synthetic bearings at the present time as far as possible, but we will have to put up with many troubles caused by them, otherwise we must use our ingenuity to overcome the several individual worries they may give to the operators.

As to the necessity of lubricating synthetic bearings I say "Yes, where it is needed." Some say it causes more friction. It may, I do not know, but to keep a mill in continuous operation we must use the best expedient even if we do sacrifice some power. Yet, I have yet to be convinced that this is true.

Every plant has its peculiar difficulties and all plants know how to overcome them. We can read test reports which always are superior to plant operation. They being run under the most ideal conditions, we want them as an incentive for better plant operation, but no one plant can say that the other plant can produce better results until it has a definite knowledge of the other plant set up.

I am sorry to say that at the present time, we do not have experienced help, and the life of machinery will not compare with the past unless the heads of departments spend more than usual hours in supervision.

G. E. REISER: There is only one point, since Mr. Pecu has brought up tonnages. The last report we had on the top 54 in. bearing was 1,000,000 tons, and the bearing was worn approximately $\frac{5}{8}$ of an inch.

R. S. SHOEMAKER: We have synthetic bearings on a 120-inch slab mill, 2-high roughing mills, and on some skin-pass, 2-high temper mills.

We do not use anything but water lubrication while the mill is in operation. As soon as we shut down the mill, if it is going to be down for half an hour or more or for the rolls to be changed, we oil the journals. In some cases we use grease, and in some cases we use oil, simply to keep the journal from rusting.

We found out early in the game that to have good tonnage from this type bearing you had to maintain the journals in first-class condition, get a dark brown polish on them. As soon as possible after starting to take a set of rolls out of any of the mills, we take the bearings off, coat the journals with a graphite solution, colloidal graphite in a volatile carrier, and in that manner protect them from rusting.

C. R. HAND: I can verify many of the experiences Mr. Pecu and Mr. Reiser have encountered. However, I can't agree on the grease or the lubrication on the necks.

I tried several different means of putting it on, half a dozen different types of each grease and oil, and I can't see where the expense required to maintain the film on necks by means of major grease system or hand application is justified. In all the cases I have run into we have lost power, ran hotter necks and did not extend the life of the roll neck bearing or the life of the neck.

We have somewhat more severe water temperature conditions at Sparrows Point than at Lackawanna. In Lackawanna it seldom goes above 65 or 70 degrees, whereas we are confronted with a temperature in the summer months of as high as 105 F. We have roll bearings run the entire winter and spring period with no appreciable wear, and in the middle of June or at the end of June we would begin to see indications that they were not going to continue, and I would be called out to tell them what to do with the bearing to stop it from coming down. Up to the present time, I don't know what to do with the fabric bearing when it starts to go down. I will be happy to learn, if anybody knows.

As far as roll neck conditions are concerned, I have seen roll necks that ran with a dull gray mat finish, and the bearings showed no appreciable wear. I have seen roll necks that had a mirror polish and would not run cool.

We do verify Mr. Reiser and Mr. Pecu in the statement that when we get the brown film on the neck, we can forget that bearing for a long time.

We have applied the bearings on the 12-inch mill rolling pipe skelp. We have all stands in that mill but the first two. On the first two stands we found no method by which we have been able to extend the life of a composition bearing, no matter whose make, to within fifty per cent of as long a time or high a tonnage as we can get out of an ordinary babbitt with a brass grid and hand lubricated with roll neck grease.

We have these bearings on the 21-inch mill, also rolling pipe skelp and sheet bar. We have them on the 18-inch bar mills, rolling 4 x 4's down to 1¾ in. x 1¾ in. We have a rod mill in which the original bearings were installed in October 1930. We have bearings in that mill all the way back to No. 3 stand, which is the fourth stand in the mill.

We have composition bearings on two 3-high plate mills, one 110 plate mill and one 160 mill. We have them on a 60-inch universal mill. We have them on two 3-high mills. We have just recently installed them on No. 1 and No. 2 scale breakers in our hot strip mill. Those scale breakers originally in case No. 1 were oil film bearing, and No. 2 were babbitted with pressure grease system.

We have run into considerable difficulty due to the extreme shock loads and the ragging on the rolls, and installed a set of composition bearings that have been going three months with entire satisfaction; No. 2 scale breaker, which was originally babbitt bearings, was changed to composition bearings last year.

In our past experience with greases on compositions, have not been able to prove that grease or oil made any improvement in bearing life, neck condition or appreciable power savings. We know that neck temperatures rise as soon as grease is applied.

The statement in the paper "with proper lubrication and fitting of non-metallic bearings, a savings as high as 35 per cent in power has been realized" is misleading. We have indicated yearly recorded savings in one mill of from 114 kw per ton rolled down to 76 kw per ton rolled. Water is used exclusively on this mill. In a plate mill our records indicate 44 kw per ton with babbitt and bronze and 17.1 kw per ton with composition bearings. Water is used exclusively on this mill.

We agree that grease or oil must be applied to all roll necks when mill is stopped for any extended period, to prevent rust and to assist in getting mill started. However, this soon washes off and further addition contributes nothing advantageous.

C. E. PRITCHARD: A complete study of the condition of the roll necks, bearing fit in the chocks, chock fit in the housing windows, arc of contact, thickness of bearing, and type of material used is believed to be very desirable and of equal importance to lubrication itself if the most satisfactory service operation is to be realized.

Both for the economics involved and maximum heat conductivity allowed it is to be expected that water would be selected as the principal lubricant for the non-metallic bearings. In order to secure the most favorable results with water as a lubricant consideration must be given as to its purity from the standpoint of being chemically inert and relatively free of suspended matter.

Any appreciable amount of foreign contaminants in the coolant and lubricating water would undoubtedly result in scoring the surface of the roll neck with consequent accelerated wearing of the bearings. Provision for a suitable type of filter installed in the main supply line to the bearings generally minimizes this possibility as well as providing additional insurance against an interrupted supply of water to the bearings due to plugging of the spray openings.

The temperature of the water used is also of extreme importance in that it has been found that a change in its physical properties is noted during a rise in temperature. In explanation, water at 65 F has a density of 62.34 pounds per cubic foot and an absolute viscosity in centipoises of 1.052, while at 100 F it has a density of 62.00 and an absolute viscosity in centipoises of .682. In addition it is known that at temperatures in excess of 85-90 F the corrosive action of any acids or salts in the water is very much more reactive with respect to attack on the surface of the roll necks.

Graphite being insoluble in acids or alkalies would undoubtedly tend to aid in resisting corrosion of the roll necks when used as a conditioning agent. Another interesting theory in connection with the use of graphite in this manner is that graphite films formed on metals promote heat radiation and absorption in addition to being more easily wetted with oil due to its lower interfacial tension.

Mr. Reiser's statement that the lubricant used must not be soluble does not agree entirely with our own experiences in that some very interesting results in the usage of a so-called soluble block grease have been noted in the lubrication of non-metallic bearings, especially where the cramped conditions as previously mentioned are encountered. It is believed that a more complete wetting action has been obtained in this manner while the high soap concentration has prevented an excessive washing action taking place.

The installation of automatic grease or oiling systems has made possible the proper control of distribution of the lubricant and also provides a means of applying same to the inaccessible spots in a safe and efficient manner.

J. L. MCDERMOTT: In a discussion of lubrication of composition bearings, one point of interest is the method of applying water. Should it be put on the neck with the spray nozzle, a hose or open-end pipe, or a pipe with slots or ⅛ or 3/16 inch holes? Also is it necessary or advisable to have high pressure water supply?

But first, why not ask what we expect the water to do? Generally speaking, regardless of what system is used, the object of applying the water is to take the frictional heat out of the neck and provide a lubricating film. When the water is so directed that it completely covers that part of the neck that is not in the bearing itself, it seems that the best cooling results should be obtained. The longer the water is in contact with the neck, the more heat it will remove, as long as the water isn't dammed up.

It has been our observation that slow-speed jobs call for different water arrangement than high-speed jobs. Slower ones seem to operate best when the entire exposed area of the neck is covered with water. At the

other extreme, high-speed jobs are found to require only a small stream of water fed into the entrance of the bearing to establish a lubricating film.

Now we come to the quality of the water used. In some areas the quality of the available water does not always contribute to the best or the longest bearing life. Various chemicals found in this water have a detrimental effect, not on the bearing, but on the roll neck itself. An etched or pitted neck is the result. This condition tends to break the water film, which in turn results in bearing tonnage somewhat under expectations. To overcome that condition, we have in various cases recommended bearings in which certain materials have been added, and which is known as a filled bearing. These fillers aid materially in removing the etching and result in a nicely polished roll neck. In some cases where close records have been kept, filled bearings have more than doubled the tonnage over bearings in which no filler was used.

Slightly scored or imperfect necks will in most cases be considerably improved through the use of these filled bearings. In other cases unusually heavy loads are encountered which tend to break down the lubricating or water film. Here again the filled bearing has a beneficial effect, as these fillers, through polishing the roll neck and removing microscopic high points, have the effect of making it easier to maintain the lubricating film. The filled bearing, of course, is not a panacea or cure-all, but where the water contains chemicals which attack the roll neck, the use of a filler will in most cases result in increased bearing life.

FRANK VOGT: One of the functions of lubrication is to maintain smooth necks and smooth bearings. Scale and grit scratch both necks and bearings, and any protection for the bearing is an aid to more efficient operation. In connection with lubrication, here are one or two suggestions which might help to relieve the scale trouble.

Experience proves that on some mills it is very difficult, if not impossible, to maintain satisfactory scale guards. In installations of this type, if the composition bearing liner is not chamfered, but left perfectly squared on the edge, the results have been gratifying. Contrary to popular belief, the water is apparently not sheared off the neck entirely at the entrance of the bearing. Perhaps the usual slight clearance provided in a satisfactorily operating bearing is sufficient to permit the entrance of adequate lubrication without permitting scale to enter.

Other installations have been made with the edge of the bearing out on a radial line instead of being out horizontally. This helps to throw the scale away from the neck so it can be washed off the ends by the volume of spent water running off the chuck.

C. E. S. EDDIE: To sum up this fine paper and its tangible discussion, water lubricated composition bearings are doing a remarkable job. They not only eliminate the cost of lubrication, reduce the bearing cost by substituting for babbitt and brass liners, but also reduce power cost for the mill operation. This is a direct economy in the conservation of power as well as strategic metals which we are using during our wartime production.

I might say that at Great Lakes we have installed this type of bearing recently in our No. 1 blooming mill. The bearings have been installed long enough to assure both the designing engineer and the maintenanceman, as well as the roller, that this new type of product known as synthetic resin or phenolic resin has proven to be a successful substitution.

The necessity of producing over two million additional tons of steel, over and above the original quota, for the third and fourth quarters of this year is, I believe, one reason why a substitution of this kind should be passed along to the industry for their consideration.

We used the old bearing chucks to house the composition liners; no additional equipment was necessary.

In making this change-over from metal to this phenolic material, it might be added that since the installation of the new liners, adjustments have not been necessary, either on the thrust or the setting of the gauges in the mill. Due to this success, we are now planning to install this same composition bearing in our No. 2 blooming mill and various installations throughout the plant. The justification for this has been evident not only in the reduced cost of blooming mill operation but also by the reduction in man-hours for machine shop work. It was necessary under the old system of babbitt bearings to change the bearings each time the roll change was made. Of course, this involved machine shop mechanics, boring, burning out old babbitt, repouring new material, which in turn had to be machined and finished ready for re-installation at the next roll change. Because of this increased life, it is not necessary to carry as many replacement bearings.

As the roll necks become polished the power input to the mill diminishes. We have been using three sets of blooming mill rolls in rotation on the same bearings. We do not find it necessary to change bearings when the roll change is made. We have experienced no trouble whatever with thrust on the collars of the bottom bearings and have entirely eliminated the thrust collars on the carrier bearings. We are planning minor changes on the bottom bearing scale guard.

It has not been necessary with this installation to use grease or oil except during periods of shut-down in preventing rust in the journals. This is a decided contribution for better performance in the maintaining of existing equipment during the present emergency.

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Building Safety INTO A Steel Plant

. . . . in the final analysis, the success of a safety program depends on top management and supervision . . . . a sound safety program brings human, physical and financial benefits . . . . in the final analysis, the success of such a program depends on top management and supervision . . . .

by H. J. Griffith

MANAGER OF SAFETY AND WELFARE

JONES AND LAUGHLIN STEEL CORPORATION

PITTSBURGH, PENNSYLVANIA

▲ MANY books could be written on the subject we are going to discuss here; so, if from your point of view, the particular problem "dear to your heart" is not mentioned, please keep in mind that we are trying to cover in a very brief space a gigantic field.

The first step in any industrial accident prevention program consists of the elimination of physical hazards due to unguarded machinery and equipment, improperly planned layout and unsafe building conditions. Every effort is being put forth to remove, so far as is possible, these hazards in steel plants today. Large sums of money have been and are being expended for the installation of mechanical safeguards and safety devices and for the replacement of unsafe equipment.

Old timers in the steel industry will recall the difficulties and sad experiences encountered around the blast furnaces when sand and water were used as a shut-off valve in the gas mains. Because of their safety features, we have installed numerous mechanical valves, some costing as much as $5000 each, in gas mains in and about the blast furnaces and also boiler house gas mains. These valves are operated by one man, in a safe position, instead of the twenty-five or thirty required to operate the spectacle-type valve, who must necessarily work in a gaseous atmosphere.

Mud guns were another headache. Many a man received severe burns while some lost their lives stopping the tapping hole after a heat had been tapped. Even after the development of the single and double barrel mechanical guns, explosions occurred, burning men severely. Today, with the electrical gun with remote control, there is no need for anyone being near tapping holes at the time of stopping the iron notch — this work is all done electrically, the operator being twenty-five feet or more away from the operation.

Open top furnaces caused considerable grief. Employes would be overcome by gas or lose their balance when dumping the charge into the top of the furnace from their wheelbarrows and lose their lives. This, and the nuisance of the charge being blown out of the top of the furnace when slip took place, was overcome by the installation of a safety feature in the form of a double bell in the top of the furnace.

There are scores of men working around furnaces today who carry scars from endeavoring to stop the cinder notch by hand. This work, like that at the tapping hole, is a tricky and dangerous operation; but with the automatic cinder notch stopper, there is very little, if any, hazard attached to the operation.

Shields around blow pipes are another safety feature which have proven well worth while. Before their placement, it was almost a certainty that when a tuyere blew out someone working in the vicinity would be showered with hot coke and other hot materials, and if he was not wearing protective clothing, which was unknown in the early days, he usually received severe burns due to his clothing catching fire.

Presented before A. I. S. E. ANNUAL CONVENTION, Pittsburgh, Pa., Sept. 28-30, 1943

Safety was a very strange word around the blast furnace until about 1912. Previous to this date, little was known about gases and their action on the human system. When necessary to make repairs to the lining of a furnace, the bell was dropped and men were sent to the furnace without any respiratory protection and they stayed until they felt the gases were beginning to affect them. In many cases, men were taken out of the furnace in an unconscious condition and instead of receiving treatment as is the case today, they were permitted to lie down and if their condition was considered serious, their bodies were put in sand. When they returned to consciousness, they were given a drink of "pop" and permitted to sit around the rest of the turn.

Today work of this nature is given considerable attention before it is started. Workmen are furnished with gas masks and a platform is placed in the furnace, in the center of which is a flue to carry off the gases. Gas detectors are used during the course of the repairs and workmen are required to wear hard hats and life lines. On a relining job about two years ago, when the furnace wall collapsed causing workmen to be knocked from wall and platform on which they were working, eighteen lives were saved because life lines were worn by those workmen. Had it not been for those safety lines, the workmen would undoubtedly have fallen to the bottom of the furnace. One man whose line was not properly fastened did fall and was killed. On a relining job, every workman on the job as well as all persons who may have occasion to be in the vicinity of the furnace under repair must wear a hard hat. This applies to general superintendent as well as office boy.

What has been stated about the blast furnace would apply to most any department in the steel industry. In the open hearth department, furnaces are larger, requiring great care in the handling of ladles by cranes. Crane cables are inspected periodically, and after a cable has carried a certain number of tons of molten metal, it is renewed regardless of how much wear is shown. No one is permitted on the pouring platform unless he is protected by the correct safety apparel such as woolen or fire resistant clothing, goggles, leather leggings and aprons. Helpers burning or digging out tapping holes also must be properly protected by wearing woolen clothing, goggles, gloves and hood to protect head and face. Men working in open hearth pits are equipped with woolen clothing and hard hats. Too much emphasis cannot be given to the wearing of safe-toe shoes. The wearing of these shoes is encouraged not only in the open hearth department but also in every department where their use is recommended by the safety department. In fact, this is the case with all protective clothing and equipment in all departments of the mill. The use of such clothing and equipment on any job requiring such protection is a "condition of employment."

In connection with finishing mills, we all know how much better machines are guarded today as compared to the exposures that prevailed years ago. The reason for this is obvious. If you do not show the men by some visible means, you cannot expect to obtain results. The aim is to have all machinery and equipment as foolproof as possible. All plans for new structures to be erected and new machinery to be installed are checked in an effort to exclude all unsafe features and incorporate the most up-to-date safety principles. Plans are checked by the engineering department and when in doubt, such plans are referred to the safety department. When our present strip mill was constructed, in order to get the 15 in. clearance between the end trucks on cranes and building columns necessary for safety, an additional $50,000 was required. This will indicate to what extent management will go to protect human life.

So much for the incorporating of safety features and ideas into a steel plant. How about the human element? At each of our works we have what is known as a central safety committee which is composed of all department heads, such as departmental superintendents (steel works superintendent, blast furnace superintendent, rolling mill superintendent, etc., chief engineer, head of employment department, etc.). This committee meets monthly, the superintendent of safety and welfare of the works acting as chairman. The general superintendent of the plant is on this committee and he or one of his assistants always attends. This committee shapes

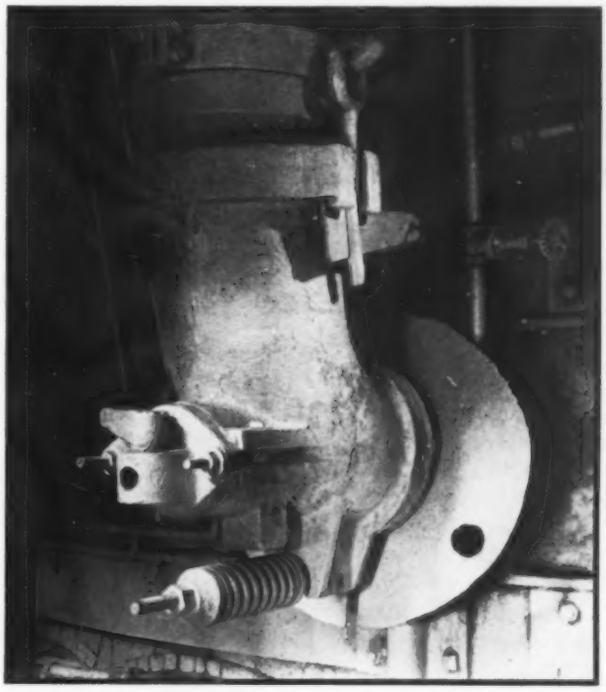

Figure 1 — Shields at blast furnace blow pipes prevent hot materials being scattered about in the event of a tuyere blow-out.

the general safety policies of the works and passes on all items of major importance. At one of our works a weekly safety and cost meeting is held. This meeting is held on Friday. Any foreman having a lost time case to any of the employes working under him has to come to this meeting and explain to the superintendent and those present just how the accident happened. This has a splendid effect in that no foreman cares to appear before the superintendent and department heads.

Each department has its own safety committee which is composed mainly of the principal foremen in that department. Some of these committees meet weekly, others bi-weekly. At these meetings departmental safety matters are discussed. This includes both the correction

of physical hazards and the correction of unsafe practices.

Every foreman holds periodic safety meetings with his men. Some foremen hold weekly meetings, others bi-weekly, and some monthly meetings. On the average, each workman attends three safety meetings held by his foreman every two months. Monthly accident reports and results of safety contests, if such have been held, are discussed at these meetings. Foremen's safety news letters, containing information which is of interest to all employes, are issued periodically by the safety department. These news letters are often used as subject matter for foremen's meetings of workmen.

Figure 2 — Group demonstrations and practice of first aid form a vital part of the safety program.

To further maintain interest in no-accident records in smaller departments, a certificate signed by the general superintendent and the superintendent of safety and welfare is awarded to each department going through the month without a disabling accident. On these certificates are placed gold seals for each month during the year which this department completes without a lost time injury. A great deal of interest has been shown in the winning of these certificates.

In addition to safety meetings, safety posters from the National Safety Council are displayed on illuminated bulletin boards throughout the plants. These posters are changed weekly. Supplementing this service at most advantageous points, "jumbo" posters, obtained from the National Safety Council, are displayed. Each new employe is given a pamphlet containing general safety rules and the company's policy on safety when he is employed.

All lost time accidents are investigated by the safety department, and an attempt is made to place the responsibility in each case. A court of inquiry is held by the safety department in all serious cases and all witnesses are called in and their stories recorded. The department head also attends this investigation with all foremen involved. After all of the facts have been procured, the safety engineer and department head place the responsibility and recommend what disciplinary measures, if any, shall be taken in the case. The chief reason for these investigations, of course, is to eliminate a repetition of a similar occurrence.

A campaign is carried on against unsafe practices. Any foreman who observes a workman doing a task in an unsafe manner reports same on an unsafe practice report form. The circumstances of the case are related together with the measures taken to correct the practice.

Plant inspections are made continually by members of the safety department. In addition, some of the departments have organized safety inspection committees to inspect their own departments for physical hazards and unsafe practices. Some inter-departmental safety inspections are also arranged whereby several men from one department inspect a department other than their own for conditions and practices which are liable to cause accidents.

In 1930 we found after investigating accidents, which were numerous at that time, that our foremen were not as familiar with the general safety set-up and rules as they should have been, so we decided upon a foremen's discussion class. These classes are attended by some 1300 foremen and are led by the safety engineer. Each foreman is required to attend class once a month, and these classes last three-quarters of an hour.

In the final analysis the success of any safety program depends on top management. If top management has been sold as to the human, physical, and financial benefits derived from a sound safety program, there is no doubt about its success.

DISCUSSION

PRESENTED BY

F. R. HAGUE, Industrial Relations, Heat Treating and Forge Department, Carnegie-Illinois Steel Corporation, Munhall, Pennsylvania

H. J. GRIFFITH, Manager of Safety and Welfare, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania

G. G. NAGLE, Safety Department, H. J. Heinz Company, Pittsburgh, Pennsylvania

J. P. JEMISON, Rustless Iron and Steel Corporation, Baltimore, Maryland

R. H. FERGUSON, Manager of Safety, Republic Steel Corporation, Cleveland, Ohio

F. R. HAGUE: For your burners and deseamers, Mr. Griffith, what protective clothing do you require, and does the company furnish it, or does the employee furnish it?

H. J. GRIFFITH: We require that they wear woolen clothing and also require them to wear gloves, goggles and leggings.

Who furnishes the clothing? The company furnishes gloves, goggles, leggings and woolen clothing. There is no charge for this material other than for woolen clothing for which the employee pays a nominal amount.

F. R. HAGUE: In relation to the safety meetings that the foremen hold in the department, are those large group meetings or small group meetings, and what success have you had in those meetings?

H. J. GRIFFITH: My personal feeling is that the foreman doesn't have any better contact with his men

than through the medium of safety meetings. I think if you are going to get anything across to the men, that is the ideal place to put it across to them.

Each foreman is required to hold two formal meetings each month with his men. He can hold a short meeting every day if he cares to, a five-minute meeting, if he wishes to. It is perfectly all right. A lot of men prefer to do that. They prefer to call their men together the first thing in the morning and talk to them before they go out on the job. A lot of meetings are held that way. But the meeting that you get the most out of, I would say, is where you have your men at a formal meeting.

F. R. HAGUE: Are the meetings large or small? Do you try to have a large group of men there or a small group?

H. J. GRIFFITH: We try to have the group not too large. In other words, each foreman probably has twenty-five to thirty-five men in his particular group. He will call his group together at least twice a month and talk to them in groups of that size.

I don't believe in getting a great big group and trying to put across a safety program to them, because I don't think you can do it. I think it is a good idea to ask questions while you are holding your safety meeting. In that way you keep the fellows awake.

MEMBER: I would like to ask whether the responsibility for the success of the safety movement is mainly with supervision, or is it a job for the safety inspectors employed throughout the various mills?

H. J. GRIFFITH: Supervision. The safety department's job is to help the supervisor do this job. In other words, the safety department is working for the supervisor. A lot of supervisors take the attitude that the safety department is just checking up on them and trying to make things difficult for them. That isn't the safety man's job at all. The safety man's job is to help the supervisor do his job, to point out the things that he sees are hazardous in a particular department, and surely the proper person to carry on the safety job is the supervisor. Who knows better about the particular things that go on in the department than the supervisor, if he is a good supervisor? He does know his job. If he didn't, he wouldn't be the supervisor. Then why should somebody who has a general idea what it is all about go in and dictate to him and tell him how to do his job? The supervisor should be responsible for safety every time.

G. G. NAGLE: I would like to ask how you would handle a foreman who worked for you for twenty or twenty-five years and is supposed to have group meetings but doesn't.

H. J. GRIFFITH: If you have a foreman working for you for twenty-five years, and you have a setup whereby you are going to have group meetings at a certain time, and he doesn't hold the meetings — well, as a safety engineer, I know what I would do. I would go to the general superintendent and tell him that he is not complying with our safety setup. And I can tell you right now that he would comply or else something would be done. That man would receive a reprimand, probably in the way of a demotion.

G. G. NAGLE: After twenty-five years?

H. J. GRIFFITH: After twenty-five years. He could be there fifty years. That doesn't make a particle of difference. After once we have established a ruling as to what is to be done, then everybody follows that ruling. It is useless to make rules unless you are going to follow them through. That is the reason we try to establish very few rules, unless we are absolutely certain that they can be carried out, because you put yourself in an embarrassing position if you put into effect rules that are not practical. I would say that this foreman either holds safety meetings or he receives a demotion.

J. P. JEMISON: Did I understand you to say that only the lost-time cases are investigated?

H. J. GRIFFITH: Maybe I didn't make myself clear, but when the lost time cases happen at night we are called out on those particular cases and they are investigated immediately, the same as they would be during the day. We investigate all cases that look as though something unsafe might have happened in that particular instance. Whether it is a minor case or a lost-time case wouldn't make any difference.

J. P. JEMISON: May I ask how you know something unsafe might have occurred, unless you investigate?

H. J. GRIFFITH: When the man comes into the emergency hospital, on the emergency hospital report there is given a brief summary of the accident. If that case looks as though there might have been something wrong, it is investigated immediately. In other words, we wouldn't run out and investigate a whole lot of eye cases, for instance, if we didn't think it was necessary. But if on that slip from the hospital it said that the injured man was grinding, or chipping, or breaking concrete, we would immediately find out what was wrong. But if the report stated it was due to the wind blowing dust in his eye, we wouldn't investigate.

R. H. FERGUSON: Mr. Jemison, did your question turn on the point as to the investigation of near accidents, where there may be no injury? Was that your thought?

J. P. JEMISON: No. I was thinking about all accidents. We have a system in our plant whereby the foreman investigates every accident, whether it is merely dust getting in the eye or something else. If a man says, "The wind was blowing and blew something in my eye," we investigate it.

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Chain AND Chain Repairs

. . . . chains should receive the same care given any high grade piece of equipment . . . . most failures are due to abuse or to lack of proper inspection and repairs . . . .

by F. W. Shaw
COLUMBUS-McKINNON CHAIN CORPORATION
TONAWANDA, NEW YORK

▲ THERE are several types of chain developed for various purposes but I will only touch on the three commonly in use in steel mill practice: iron, BBB steel, and heat treated alloy steel.

Iron or dredge chain which was, for many years, the most popular for sling chain purposes, is made from double refined iron, the bars are cut to length, ends scarfed, and welded into chain by trained chain makers, actually a specialized blacksmithing operation. The chain is then proof-tested to about twice the safe working load and if found up to standard, i.e., no weld failures or cracks or excessive elongation, the chain is then made into slings by attaching hooks, rings, etc., and tested again to check on the necessary joiner links between the attachments and chain proper. Most chain manufacturers issue "certificate of tests" with each chain shipped. In many cases the chain is shipped in running lengths and made into slings by blacksmiths in the mills.

The reason for using iron chain for so many years is because it is supposed to "stretch and give warning before failure in service." One of the main reasons for the popularity of iron chain is that it can be welded by the fire weld process even under rather wide range of temperatures — in other words, because of its weldability.

Iron chain should be periodically annealed to restore to some extent the original grain structure of the metal. However, this procedure was found to be too costly, bothersome, and uncertain; then too, after each annealing, even if the job was handled under ideal conditions, which would be indeed unusual, the material becomes too ductile, resulting in the chain being stretched and oftentimes ruined.

Presented before A. I. S. E. ANNUAL CONVENTION, Pittsburgh, Pa., Sept. 28-30, 1943

It became apparent that a chain must be developed to eliminate the above procedure. It was then that we pioneered heat treated alloy chain which I will attempt to cover shortly.

BBB steel chain is made by either electric butt welding or by the same process as used in making iron chain, i.e., blacksmith welding. BBB chain in some cases is preferable to iron chain providing, of course, the welding is of high quality. The safe working loads are about the same and the resistance to abrasion is probably greater in the steel chain. There is considerable disagreement between large chain users as to the more desirable, low carbon steel or iron chain.

However, I feel safe in saying that we have less trouble and complaints from steel chain than from iron and I believe this is largely due to the fact that steel is made under much better conditions and the elements under closer observation and control than is iron.

BBB steel chain is given proof tests to about twice the safe working load.

About ten years ago we developed our alloy steel chain to meet a definite demand for a product that would reduce the hazards daily encountered with the use of the old types of chain. First, we had to conduct many tests to obtain the proper analysis of steel that would weld satisfactorily in our electric butt welding machines. Second, we had to secure a material that was ductile to avoid any brittleness in the chain. Third, we required a raw material higher in elastic limit and ultimate strength than heretofore available. Fourth, we were looking for a material that would resist abrasion to a much higher degree than anything we had previously used. Fifth, we had to have a material that would readily respond to heat treatment. Sixth, finally we hit upon a modified analysis of SAE 4615; the alloys, nickel and molybdenum with low carbon content seemed to be ideal.

Some of our operations in the manufacture of chain are as follows:

1. Chain is formed in special forming machines from steel coils.
2. Links are electric butt welded in special automatic machines.
3. Chain is tested as it comes from the welders to insure perfect welds.
4. Chain is then heat-treated and drawn.
5. Re-inspection and proof-test.
6. All master links or rings, connecting links, hooks and attachments are made from same material as the chain.
7. Sling chains are made by joining chains, hooks, rings, etc.
8. Sling chains are again proof tested to test joiner links, etc.

The result of this development gave us a chain that is more than twice the tensile strength of the old-fashioned types of chain, for example:

¾ in. alloy chain weighing 5.5 lb per ft has a safe working load of 28,000 lb and to match this strength with iron chain we would have to go to 1¼ in. chain weighing 13.5 lb per ft. Naturally this type of chain is rapidly replacing both iron and low carbon steel or BBB chain in steel mills.

Other outstanding features of alloy chain are:

1. It carries a Brinell hardness of from 250 to 350, therefore, has much greater resistance to wear.
2. Its material, after heat treatment, has approximate tensile strength of 125,000 psi, whereas iron has about 48,000 and low carbon steel 55,000 psi.
3. Alloy chain never requires annealing.
4. It will not develop work hardening or brittleness nearly as rapidly as other types of chain.
5. Alloy chain will outwear any other type of chain now available.
6. When repairs are necessary, chains should be returned to the manufacturer, at which time all defective, bent, gouged, stretched or deformed links and attachments are replaced. The chain is again heat treated, and a final proof tested chain, having been reconditioned, is oftentimes as reliable as a new one.
7. It will stretch at least 15 per cent before failure, thereby giving ample warning of overloading.
8. It has high impact resistance to withstand suddenly applied or shock loads.

SELECTION OF CHAIN

From the above it would seem sound judgment to select alloy chain whenever possible. However, a lot of common sense should be used in specifying the size and construction of sling chains to insure proper safety factors at all times. It is much better to buy an oversize chain, regardless of published safe working load tables. In addition to a greater factor of safety, your chains will last enough longer to more than pay for the slight increase in initial cost.

Hooks and other attachments should also be carefully designed.

Double branch slings should be considered carefully, for as the angle between the legs increase the safe working load decreases. As an example, when the legs of a ¾ in. sling are 60 degrees apart, the safe working load would be 49,800 lb and if this angle is increased to 120 degrees the safe working load would be reduced to 28,000 lb.

INSPECTION AND INSPECTION RECORDS

Most mills have chain inspectors who are trained to detect any signs of defects such as cracks, stretching, weld failures, cold working, wear, etc., and are given authority to condemn and remove from service any chains that, in their judgment, are unsafe for further use.

Inspection records in my opinion are essential to insure that chains are regularly inspected and a record made of the condition of these chains as of that date.

Manufacturers of alloy sling chains give each a serial number; this number is either stamped on end master links or a small flat link is stamped and attached to one end of the sling. A complete record is kept in the manu-

SLING CHAIN DON'TS

Don't overload a chain.
Don't take chances; if a chain does not look safe or does not pass inspection, repair or discard it.
Don't force a chain or hook into position by hammering.
Don't carry a load on the point or tip of a hook.
Don't insert the point or tip of a hook into a chain link.
Don't let a load rest on a chain.
Don't drag a chain from beneath a load.
Don't roll over objects with chain — use ropes.
Don't consider a chain safe because it is new· a new chain can be ruined by a single overload.
Don't trust a chain with stiff or stretched links.
Don't allow weights to fall on a chain.
Don't carry an unbalanced load.
Don't, under any circumstances, use chains that are excessively pitted or corroded.
Don't allow chain to be exposed to extremely cold weather for any length of time.
Don't apply sudden loads to extremely cold chain; this applies specifically to iron crane and BBB chain.
Don't anneal or normalize alloy steel chain.
Don't forget periodic and careful inspection.
Don't fail to use good judgment and common sense at all times.

facturer's files covering size, type, name of customer, date shipped, and date returned for repairs.

A record should be kept by the user to cover each sling chain and carry the following information:

Chain serial number.
Purchase requisition.
Size and type of chain.
Grade of chain: iron, carbon steel or alloy steel.
Purpose of use or department.
Reference to manufacturer's certificate of test.
Maximum permissible working load.
Date when placed in service.
Date of each inspection.
Date of any repairs.
Reason for return.
Date of return to service, etc.

DEFECTS TO LOOK FOR IN NEW AND USED CHAINS

1. Inspect the links on chains which have been heavily loaded; if badly stretched (as much as 10 per cent) the chain should be replaced; if the stretch is less than this figure, annealing may be needed unless the chain is of the alloy steel heat-treated type, which should never be annealed.
2. Examine the link juncture points. If the areas are worn bright or materially larger than needed for normal contact, the links probably are being subjected to twisting and shearing stresses by misuse.
3. If the link juncture points are badly worn, this would indicate that the chain had been subjected to twisting loads or abrasive conditions and corrective measures should be taken immediately.
4. Examine links at the hook ends of chain carefully for signs of all abrasion or other damage coming on one or two links; replace such links and correct the operating conditions.
5. Measure the load hooks, especially if used for hooking over chain. Slightly deformed hooks can be straightened but if they are badly bent they should be replaced with new ones as the bending and straightening will cause serious loss of strength.
6. Examine all links for signs of stretching, gouging, cracks, weld failures, excessive wear, cold working (this condition is possibly the most dangerous and the most difficult to discover — the metal fracture with little or no elongation and before fracture a highly polished, hardened surface, with tiny cracks may be observed by close examination).

MAINTENANCE AND REPAIRS

All mills have a blacksmith shop where repairs are made on carbon steel and iron chains but all alloy chains should be returned to the manufacturer for repairs and reconditioning. When alloy chains are returned to us they are first cleaned by pickling; then all defective links and attachments are removed and replaced; the chains are then heat-treated, and proof tested (and certificate of test issued) before they are returned to the customer. This procedure greatly prolongs the life of chains. When an ordinary chain fails in service and is sent to the blacksmith shop for repairs, too often adjacent links to the break should be replaced but are overlooked, one link welded in, and a few days later back comes the same chain for repair of the same link or other links that should have been replaced at the time the chain was first repaired.

Proper storage of idle sling chains is important and in the average mill this is entirely ignored. We strongly suggest that more attention be paid to a better housekeeping system — it will more than pay for itself. Special racks should be constructed with pins extending on which idle slings may be stored. These racks should be, as far as possible, installed in a clean, dry room. Chains thus stored may be easily selected for use when needed. The supporting pins should be so arranged to avoid lifting hazards to workmen — usually a small crane may be used to hang the chains on the pins.

Heavy chains may be neatly piled on a raised platform and covered to keep them clean and dry.

WHEN TO REPLACE SLING CHAINS

This matter is one to be handled with good judgment on the part of your chain inspector. It is false economy to demand the last lift from a chain that should be replaced. It is often that last lift that causes accidents and perhaps serious injury to workmen or equipment — then too, delay is encountered in running for a new chain.

Derating of chains means that comebody is trying to get this last lift before scrapping or repairing the chain. Old chains are placed in departments where the average lift is lighter. This, in our opinion, is dangerous because the workmen do not know or understand what has taken place and he uses the chain on a lift far heavier than was intended after the "derating."

The chain manufacturers as an industry are trying to make better and better chain and many definite improvements have been made in the past few years. Most failures of chains are actually due to abuse and to lack of proper inspection and timely repairs.

Good chains are expensive and should be treated with the same care as any other high grade piece of equipment. This will more than pay for itself and you will be surprised to learn how much can be saved by following some of the accompanying suggestions, even if they are a little inconvenient to install.

DISCUSSION

PRESENTED BY

O. A. BAMBERGER, Superintendent Mechanical Department, Republic Steel Corporation, Massillon, Ohio

W. W. SCHEEL, Metallurgist, Republic Steel Corporation, Canton, Ohio

STANLEY GRAND-GIRARD, Electrical and Mechanical Superintendent, Sharon Steel Corporation, Sharon, Pennsylvania

F. C. SCHOEN, Assistant Master Mechanic, Midvale Company, Nicetown, Philadelphia, Pennsylvania

O. A. BAMBERGER: Our problem has been in getting alloyed chains repaired at the factory during this war so we can keep them in service. It seems that the manufacturers of alloyed chain are all tied up with government orders and we don't seem to be able to keep our mill supplied with repaired chain.

About a year ago, our corporation formed a Chain Committee, of which I was made chairman, to investigate and try to find out how to repair our own alloyed chains. We have done a lot of experimenting along this line and Mr. Scheel, of our metallurgical department in Massillon, Ohio, who is in charge of this work, is here to report his findings. He has a report that I believe will be interesting to all of you.

W. W. SCHEEL: Because of a shortage of chains in our mills, the writer's company initiated a program of study on chain repairs. Previously, all alloy chains had been returned to the manufacturer for repair. However, at that time, due to the over crowding of repair facilities in the manufacturers' plant, chains sent back for repair were held up for periods up to six months and longer. Consequently, a scarcity of available alloy chains developed in our mills to the point where the situation had become acute.

A suggestion was made for the use of repair links in the replacement of broken or damaged links in alloy chains. These links were to be inserted in the chain at the proper places and closed by means of an electric arc weld with a suitable welding rod.

The thought behind this idea was, of course, that by the use of such a method, the original chain would not be subjected to excessive heat during the repair and would not need, therefore, a subsequent heat treatment. The chief problem would be in determining a suitable welding rod, a material suitable for use in making the repair links, and the development of a welding technique which would result in a weld that would exceed or at least equal the strength of the original chain.

Research on the problem has been carried on by the mill welding department in conjunction with the metallurgical laboratory. Results have been quite satisfactory thus far and it is believed that the ground work has been rather well established. More data has yet to be collected on different types of welding rods and strength of some link sizes not yet tested. However, this report will attempt to present the information obtained from work done thus far.

MATERIAL FOR REPAIR LINKS

Strength, toughness, resistance to abrasion and resistance to grain growth were the qualities thought to be required in a chain repair link. Consequently, SAE 2515 (a 5 per cent nickel alloy) was chosen for the job. Tensile tests showed a strength of 120,000 psi in the hot rolled condition. Its toughness and resistance to grain growth at elevated temperatures are well known, and it was believed that this type of steel would meet the requirements satisfactorily.

WELDING RODS

Weld metal deposit should be expected to have properties similar to those required in the repair link. Type 310 (25 per cent chromium, 20 per cent nickel) stainless steel rod was suggested as a suitable type due to its toughness, relatively good strength, ability to work harden, and good weldability. Other types of rods were also tested, including Fleetweld No. 5; 18-8; modified 18-8 containing 3-4 per cent manganese and 1 per cent molybdenum; modified type 309 with 25 per cent chromium, 14 per cent nickel and low silicon; and some other types not extensively tested since first tests did not look promising.

Figure 1 — The first tests were hand forged into open links.

Availability of various types of rod was also considered, due to alloy shortages and heavy industrial demands. Although the higher alloy types would possibly result in better welds, their scarcity would prohibit their use to any great extent. Consequently, considerable attention was paid to results obtained with lower alloy types of rod such as Fleetweld No. 5, 18-8, and the modified 18-8 type. Results obtained with these various rods will be given later in the report.

PREPARATION OF TEST LINKS

The first tests prepared were forged by hand into an open link. This was inserted between four alloy links to form a five-link test with the test as the third or middle link (Figure 1). The open ends of the test link

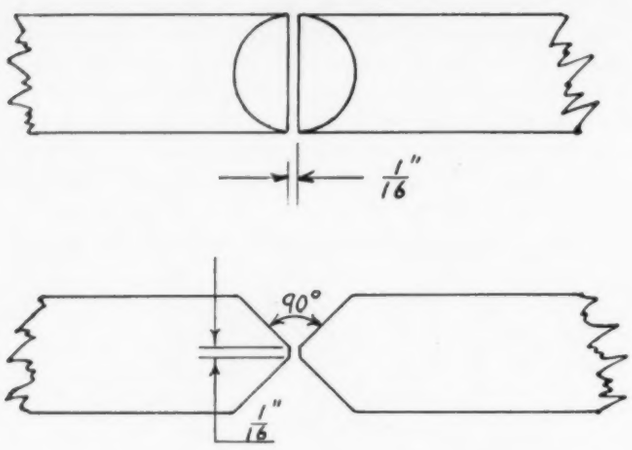


Figure 2 — Sketch shows dimensions of bevel used on links for welding.

were given a 45 degree bevel on each side so that a fillet of 90 degrees was formed for welding, and a metal thickness at the point of the bevel of 1/16 in. was maintained. A gap of about 1/16 in. was left between the two ends so that 100 per cent penetration at the center of the weld would be obtained (Figure 2). These tests were welded and then broken in a beam type tensile machine (Figure 3). The beam tensile value, or total force required to break the test, was used as a measure of the strength of the weld. Frequently however, with this type of test the original resistance welded links failed before the test link. Consequently, the ultimate strength of the weld was not obtained. Therefore, later tests were made on single welded links, on which the load was applied until either the weld or the link proper failed.

Bending jigs for each size link were also developed to form the repair links on a production basis (Figures 4 and 5). By this means the links are formed to constant size and shape with much less difficulty than by hand. These jigs have worked quite satisfactorily.

WELDING OPERATIONS

A great deal of care must be taken in the preparation of the links for welding. As stated before, a constant gap of 1/16 in. should be maintained between the ends of the link, otherwise incomplete penetration from both sides results, with a subsequent low strength. All scale should be ground or sand blasted from the surfaces to be welded.

In the present practice of chain repair, the replacement links are obtained from the forge shop where they are made, in the closed position. They must be reheated at the place of repair, bent open, inserted in the chain and closed. Care must be taken in this operation to leave a sufficient gap between the ends for complete penetration.

The strength of this type of weld depends to a large degree upon the skill of the welding operator. Care must be taken that about the same welding procedure is used on each link so that constant results are obtained. In the use of stainless steel rods, a minimum of current must be used for best results. This requires the operator to use a short arc in his manipulation. The comparatively short length of travel in making the fillet welds requires good judgment in the estimation of the proper stopping point before over heating and metal run off occurs.

It has been found that the first fillet bead laid down has a tendency to run through and form sharp corners on the opposite side. These corners contain slag and oxides, impossible to clean out. When the bead is laid on the opposite side the slag and oxides are trapped in the weld metal, forming a porous weld which is low in strength. This may be prevented by use of a copper backup under the first pass, which holds the molten metal in place until it solidifies.

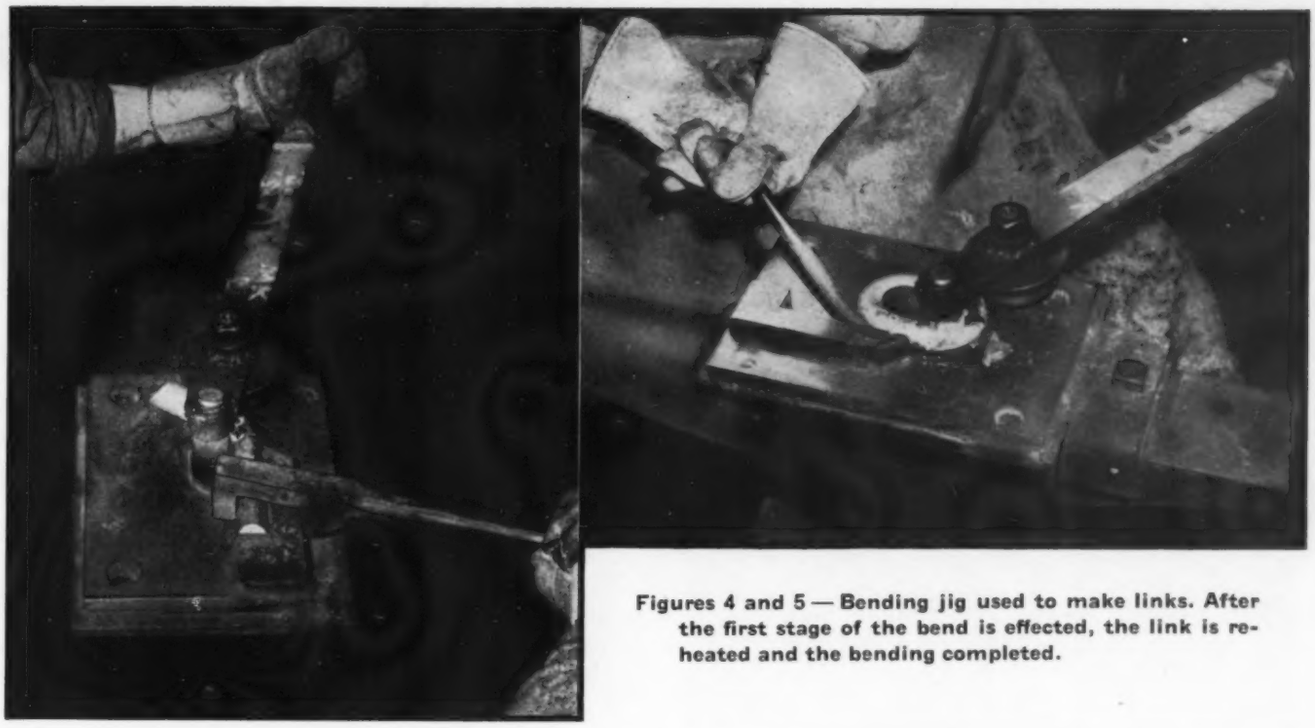
EFFECT OF PEENING

Some experimentation has been done with peening or hammering the weld metal as it cools. This operation appears to be especially effective on austenitic types which are improved by cold work. Results obtained have indicated that peening in most cases has improved the tests to a great extent. One effect of peening is to relieve the stresses set up in the cast weld metal during cooling. These stresses are greater in the austenitic deposits because of the greater coefficients of expansion and contraction of this type of structure and are likely to cause stress cracks if not relieved.

In addition to relieving stresses, peening undoubtedly improves a weld by helping to break down the large grained cast structure to a certain extent, thus relieving somewhat any tendency to brittleness. It also work hardens the structure to a certain degree, thus raising the strength of the weld.

Peening may be done by hand with a ball head hammer, or by a small air driven hammer. The latter method is being used in our weld shop and appears to be quite satisfactory both for descaling and for peening.

Figure 3 — Test links are broken in a beam type tensile machine.



Figures 4 and 5 — Bending jig used to make links. After the first stage of the bend is effected, the link is reheated and the bending completed.

EFFECT OF PREHEATING

Considerable variation in the tensile results obtained from our first tests was observed. In many cases these variations were not explainable from the standpoint of any known cause other than possibly the operators technique. This variation was observed on larger size links (¾ in. and above), while the smaller sizes were fairly consistent in strength. It was found after some observation that fine cracks, which usually occurred in the first few weld passes of the fillet, were the cause for the variation. These cracks were the result of the chilling effect of the greater mass of metal in the larger links, which caused the hot weld metal to cool very rapidly, resulting in high cooling stresses and subsequent cracking in the weld (Figures 6 and 7).

The fracture of such a weld, after being pulled apart in the tensile machine, was characterized by a dark blue or black center where the crack had occurred. These fine cracks are not welded shut by succeeding layers, but are oxidized, and thus exhibit a blue black appearance when exposed (Figure 8).

This type of cracking was found to be eliminated by preheating the link to nearly a red heat before welding. The heat retained by the link prevented rapid cooling of the weld metal, and thus, no harmful stresses were set up in the weld metal to cause cracking (Figure 9).

EFFECT OF WELDING MACHINES

Some observations were made on the effect of different types of welding machines on the chain welding operation. A stable arc machine is to be desired which will not build up to an excessive current value as the arc is broken. Preferably, a machine should be used which has an a-c motor drive. D-c driven machines will have a tendency to vary in speed if heavy machinery is hooked in on the same source of power supply. Our overall experience has indicated a higher average strength from test welded on a-c driven machines with stable arc characteristics. For welding rod sizes below ⅛ in., a 200 or 300 ampere machine has been found to be more suitable than a higher capacity machine. This is thought to be true because of the more stable arc characteristics of the lower capacity machine at low current values.

DISCUSSION OF RESULTS

The safe load limits adhered to in our plants for various size chains and the breaking strength required of electric arc welded links are given as follows:

Chain size, in.	*Safe load limit, lb*	*Minimum breaking strength of weld, lb*
⅜	2,700	10,800
½	4,500	18,000
⅝	6,900	27,600
¾	10,100	40,400
⅞	14,000	56,000
1	18,600	74,400

It was believed necessary to maintain a minimum weld strength of four times the safe load limit normally adhered to, in order to insure against all accidents. The most important consideration in this type of repair is that the per cent weld failures must be maintained at zero. In other words the efficiency of the method must be maintained at 100 per cent. One failure may mean one or more serious casualties. In order to maintain this high efficiency a high factor of safety must be enforced with rigid control exercised over the whole procedure. Quality of the weld must not be sacrificed for speed, cost reduction or any other consideration in the repair operation, for men's lives may sometimes depend on the strength of a chain.

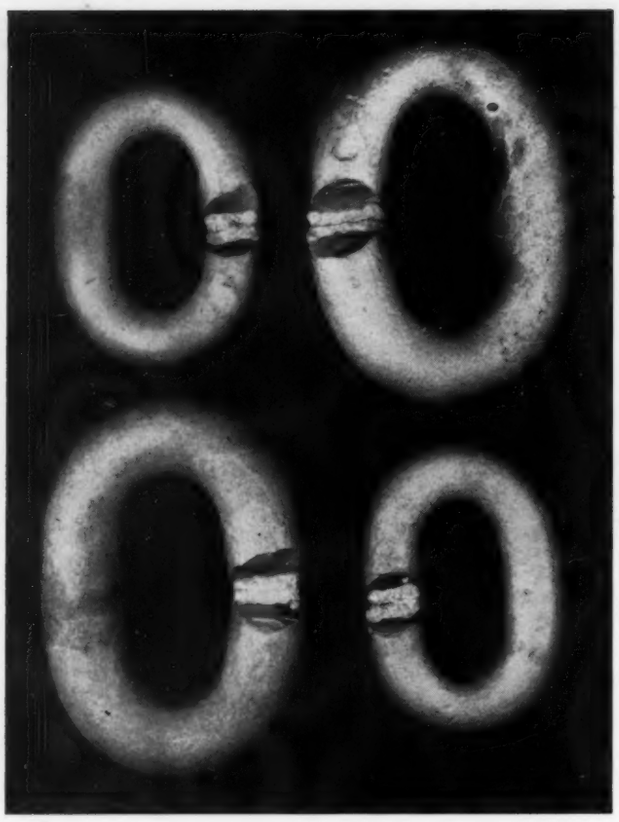


Figure 6 — Illustration of cracking which occurs in first or second pass of the fillet weld when links are not preheated.

Average results of various tests made over the whole period of testing follow. Figures given are the ultimate strength of the test as measured in beam tensile values.

¾ in. chain, five-link test, middle link welded.

Type rod	*25-20*	*18-8*	*No. 5 Fleetweld*
Average strength, lb	30,000	23,000	35,000
Maximum strength, lb	39,000	32,700	47,300
Minimum strength, lb	23,100	19,200	28,400

In these tests no preheat was used and no peening was done. The welding operator was relatively inexperienced in the use of stainless steel rods.

The second group of tests was considerably better, reflecting improvement in welding technique and effects of peening.

¾ in. chain, five-link test, middle link welded.

Type rod	*25-20*	*18-8*	*Fleetweld No. 5*
Number of tests	5	4	5
Average strength, lb	48,000	43,000	50,000
Maximum strength, lb	65,500	46,400	62,300
Minimum strength, lb	46,700	29,500	47,700

These tests were not preheated. However the maximum values shown were obtained by peening. Although the Fleetweld No. 5 values are somewhat higher, the build up on the outside of the weld was considerably greater on all these tests than on the 25-20 and 18-8 welds. This undoubtedly affected the results.

Some results of additional tests made on single links, in various sizes, are given. Testing was confined to stainless steel rods. Although good results were obtained from No. 5 Fleetweld, it was believed that more resilient and tougher welds could be obtained from stainless steel rods. This was indicated by more variation in results obtained with the No. 5 Fleetweld rod.

⅞ in. single links, minimum strength 56000 lb

Type rod	*25-20*	*25-14*
Number of tests	10	10
Average strength, lb	84,000	78,000
Maximum strength, lb	95,700	94,600
Minimum strength, lb	53,100	40,300

The maximum and average results were obtained from tests which were preheated before welding. The minimum strength values were obtained from tests not preheated. All tests were peened during welding.

¾ in. single links, minimum strength 40,400 lb

Type rod	*25-20*	*25-14*	*18-8 modified*
Number of tests	10	10	3
Average strength, lb	55,000	56,000	65,000
Maximum strength, lb	77,400	78,300	69,600
Minimum strength, lb	45,400	47,800	49,500

The maximum and minimum values were obtained from preheated tests. The minimum values shown were obtained from tests not preheated. All tests were peened during welding. The results of the 18-8 modified weld look very good but they are based on only three tests. More tests are to be made as soon as welding rod is obtained.

⅝ in. single links, minimum strength 27,600 lb

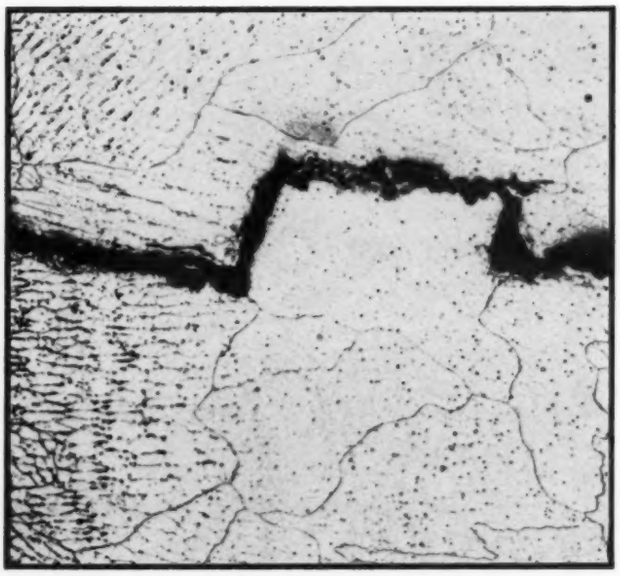
Type rod	*25-20*	*25-14*	*18-8 modified*
Number of tests	4	2	2
Average strength, lb	50,000	.....	.....
Maximum strength, lb	57,100	33,400	42,400
Minimum strength, lb	44,500	31,800	38,200

½ in. single links, minimum strength 18,000 lb

Type rod	*25-20*	*25-14*
Number of tests	5	5
Average strength, lb	36,000	34,000
Maximum strength, lb	42,400	38,100
Minimum strength, lb	30,200	21,300

None of ½ in. or ⅝ in. links were preheated before welding. Little difficulty has been experienced in main-

Figure 7 — Photomicrograph showing internal stress crack in weld as indicated in Figure 6 (chromic acid etch X100).



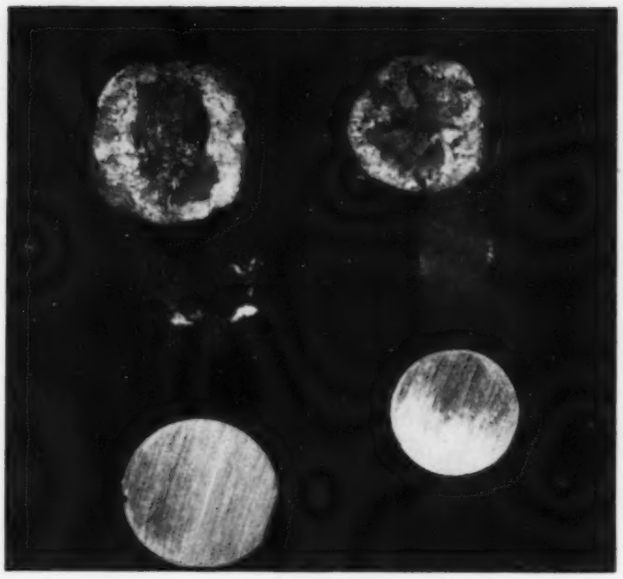


Figure 8 — Photograph showing fracture of welds which had stress cracks in first beads of the fillet.

Figure 9 — Macroetched cross section of ⅞ in. link weld. Link was preheated before welding. Note absence of cracks in weld.

taining the required strength on the smaller size links.

On the ¾ in. and ⅞ in. links, ⅛ in. welding rod was used while on the smaller sizes $\frac{3}{32}$ in. diameter rod was used. It is preferable to use a smaller size rod for the first pass at the base of the fillet in order to get maximum penetration; $\frac{3}{32}$ in. rod has been used on ¾ in. links with satisfactory results, but, since the smaller rod is more expensive, it is advisable to use a larger size wherever possible without affecting the strength of the weld adversely.

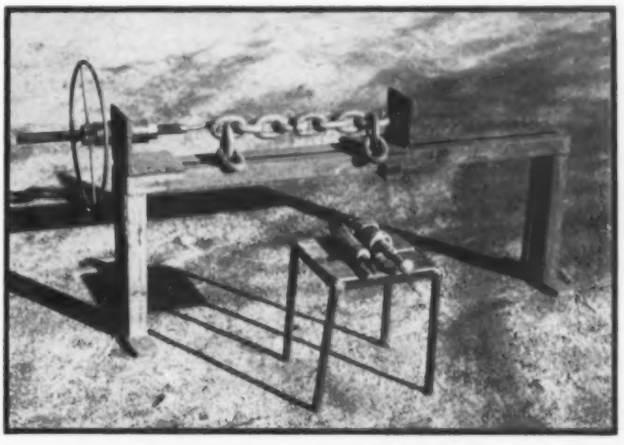
CONCLUSION

In summing up work done thus far on the problem of chain repair the following conclusions should be emphasized:

1. A 5 per cent nickel steel (SAE type 2515) has proven quite satisfactory as a material from which to forge repair links for arc welding. No excessive grain growth has been observed, the link has proven adequately strong, and the weldability has been good. Very few failures have occurred in the weld junction or the weld effect zone.
2. Of the welding rods experimented with thus far, the 25-20 rod has shown consistently good results. Welding is easily performed with this type of rod and it develops good strength and structural characteristics. Results obtained from Fleetweld No. 5 were fairly high. However, more inconsistent results were obtained from this type of rod than the austenitic types; consequently, it is believed better to use austenitic type rods.

   The 18-8 rod was not satisfactory. However, the modified 18-8 type rod containing 3-4 per cent manganese has shown very good strength and should be satisfactory if further tests show similar results.
3. Peening the weld metal during cooling improves the strength of the link by relieving stress, breaking up the weld structure and work hardening the weld.
4. Preheating before welding is necessary on larger size links in order to prevent stress cracks in the first beads of the fillet.
5. Repair links should be carefully prepared for welding. All scale should be removed from the surfaces to be welded. The bevel should conform to the dimensions given before, and a gap of at least 1/16 in. should be left between the ends of the link. Use of a copper back up block is recommended to prevent metal run-through on the first pass.
6. A trained skillful operator should do all the welding on chains in order to insure the best possible welding technique. Also, in case of a failure, a check on who made the weld would be simplified.
7. One welding machine should be used for all repairs. This machine should have stable arc characteristics in the current range of operation.

Figure 10 — This jig was devised to hold the chain while the repair links are being welded. Air tools for grinding and peening are also shown.



8. At least one chain in every fifteen should be tested on a tensile machine as a check on the quality of the welds.

STANLEY GRAND-GIRARD: During the winter of 1935 we were having a number of broken sling-chains in our billet yard. Chains had broken on several cold days at the beginning of the turn for no apparent reason except that which could be contributed to cold weather. We found that the men were holding the chains over the coke jacks to warm them or to take the frost out of them before starting to work.

To improve the operating conditions we investigated, and then adopted the use of alloy steel chains in this yard. Instead of the 7/8 in. standard steel chain we adopted a 3/4 in. alloy chain and also changed the style of our slings, using one long chain without ring on end of it and one short chain with a grab hook on the end.

This made it easier to slip the long chain under a pile of steel and easier to adjust the length of this sling by placing the long chain on the grab hook at the desired length.

I have recently checked the record of our alloy chains, all of which were placed in service in 1935 with the exception of one set installed in 1937. These chains have varied in time of service between repairs from 3 to 30 months. We send our chains back to the manufacturer for repairs, and the repairs have averaged one repair per chain per year.

F. C. SCHOEN: We, in our plant, use a great deal of chain which is purchased under the supervision of the boss rigger who is also responsible for chain inspection but not its repair.

As Mr. Shaw states — we are one of the plants with its own blacksmith shop where all chain repairs are made.

It has been our experience that, considering the abuse to which chains are daily subjected, the most economical chain is iron or dredge chain purchased in running lengths and made up into sling and hook chains as required. When handling hot and cold forgings and ingots, especially when piling is a necessity, the "Don't drag a chain from beneath a load" is usually disregarded. We are, however, usually able to enforce the practice of warming or taking the frost out of a cold chain before its use.

The practice of derating a chain is followed only in case a good grade of alloy chain is removed from a crane due to length of service and put in a shop in place of an iron chain. Iron chains are never derated; the condemnation tags mean "condemned for further use".

A. I. S. E. SPRING CONFERENCE

under the auspices of the

ROLLING MILL COMMITTEE

Tentative Program

"Operating the Continuous Furnace by Automatic Temperature Control"

"Heating and Rolling in Bar Mills"

"Motor Application for Merchant, Bar, Billet and Rod Mills"

"The 26 in. and 22 in. Mills at Atlas Steels, Ltd."

"Rolls and Roll Making"

Monday, May 8, 1944 Wm. Penn Hotel

PITTSBURGH, PENNSYLVANIA

Electrotinning Operations

. . . . built for DPC by Republic, each of these two electrotinning lines are designed toward the production of high quality plate under carefully controlled conditions . . . .

by H. P. Munger

SUPERINTENDENT OF ELECTROPLATING

REPUBLIC STEEL CORPORATION

WARREN, OHIO

▲ IN the design and operation of an electrotinning line there are three distinct features which should be kept in mind. First in importance is the production of the highest quality of product. Secondly, is a flexibility of operation to produce the various grades of plate required by the customer, and finally, is a high tonnage production rate with its accompanying low operating cost. The two electrotinning lines, which Republic Steel Corporation has installed, have been designed with these three points constantly in mind.

An electrotinning line is so complicated that it will be possible to give only a limited description of the major units and their functions. It will be evident that a technical paper could be written around many of these major units. It is hoped that the factors entering into the design and operation of these units may be discussed in more detail at a future meeting.

GENERAL DESCRIPTION

The electrotinning equipment has been installed at Niles, Ohio, in the Warren District, there being two identical lines, each 540 ft long, with estimated normal production capacities of 1,800,000 base boxes per year each. The length of strip in each of these lines is 875 ft. Each is designed to process strip from 16 in. to 38 in. wide and from 36 gauge to 22 gauge (.007 in. to .030 in. thick). The strip is side trimmed before being delivered to the electrotinning lines. Coils 15,000 lb and up to 62 in. outside diameter may be processed. Larger coils up to 30,000 lb may be handled by making necessary changes in the uncoilers. The normal operating speed is 500 fpm with a coating weight of 0.50 lb per base box The design speed of the line is 1,000 fpm. The line is powered with 230 volt d-c motors using the variable voltage system for speed control. All of the motors as well as the motor generators are insulated and built for 300 volt operation. This increases the maximum line speed from the nominal 1000 fpm at 230 volts to 1300 fpm at 300 volts. Each line receives its a-c power from a unitized substation located as near as possible to the center of the electrical load. The auxiliary constant speed motors are 440 volt, 60 cycle, 3 phase. The electrical control basement is 300 feet long and 19 feet wide. The air for cooling this basement is handled by two 40,000 cfm fans and is cleaned of dust and dirt in an electro-static air cleaner. This cleaner is equipped with a semi-automatic washer for removing the dirt from the plates of the cleaner.

ENTRY ZONE

The entry zone (Figure 1) includes two uncoilers capable of handling the maximum weight coil up to 62 in. in diameter. The uncoiler is an expanding cone type with a 1½ hp gear motor for the expansion drive. Each cone of the uncoilers is connected to a 15 hp motor which operates as a drag generator.

The steel is fed from the reels with a four high pinch roll unit into a double hydraulic crop shear. In this pinch roll unit, the one pair of rolls is for the strip from the No. 1 uncoiler. The other pair of rolls is for the No. 2 uncoiler. The double crop shear is used to cut off the leading end of the coils before welding.

The ends of the coils are joined in a welder having a 75 kva water-cooled welding transformer and equipped with air operated strip clamps and a down cut hy-

Presented before A. I. S. E. ANNUAL CONVENTION, Pittsburgh, Pa., Sept. 28-30, 1943

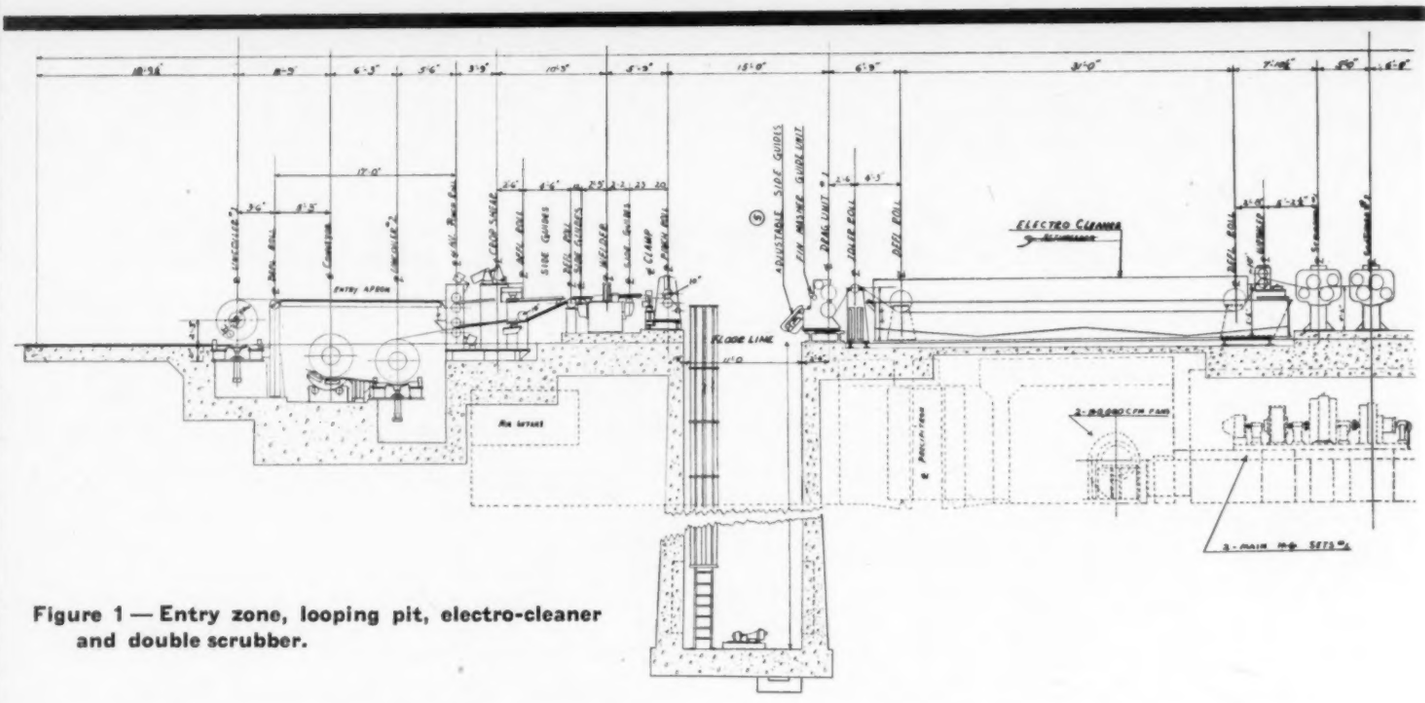


Figure 1 — Entry zone, looping pit, electro-cleaner and double scrubber.

draulic operated crop shear. When a weld is to be made, the line speed is reduced to 100 fpm and the entry zone stopped. The trailing end of the strip is cropped in the welder, the leading end of the succeeding coil which has been previously cropped is clamped in position and a double seam weld is made. Each of these welds is within $\frac{1}{8}$ in. of the end of the strip.

A two high pinch roll using a 30 hp drive delivers the strip into the looping pit. Should the strip be out of line an automatic self-centering side guide is used before welding, to recenter the trailing end of the strip. In operation this self-centering guide follows the lateral movement of the strip while it is in motion. The guide consists of two photoelectric cells and the control equipment to drive a reversible motor. If the strip moves to one side, it cuts the light beam of the photo cell and this operates the motor to move the carriage in the direction the strip has moved until the light beam is in the clear. Since this carriage is constantly following the strip it is centered on the strip path at all times. When the end of the coil has been reached and this end is not centered on the pass line, an air valve is opened which clamps the strip in this guide and at the same time opens the two high pinch roll which delivers the strip into the looping pit. Limit switches are operated which start the motor in the direction which will move the strip to the center of the pass line. When the carriage reaches this point limit switches will stop its motion and the strip is now in the center of the pass line. The strip is now clamped in the welder and the valve operating the self-centering device is opened, which releases the clamp and recloses the two high pinch roll. The strip is now in a position to be welded as mentioned above.

The entry zone is separated from the processing zone by a looping pit which is 11 ft long, 10 ft 3 in. wide, and 40 ft deep. The speed of the entry end and the position of the loop are controlled by photoelectric cells located at the bottom of the looping pit. A limit switch is located at the top of the looping pit to stop the line before completely losing the loop.

PROCESSING ZONE

The strip coming from the looping pit is guided into the No. 1 drag unit by fin mashers. The drag unit consists of two tension rolls, rubber covered, 18 in. x 48 in. with one pressure roll, rubber covered, 10 in. x 48 in. A 75 hp variable voltage d-c motor is used as a drag generator.

All of the tension and drag units have a design similar to the No. 1 drag unit.

The electrocleaner tank (Figure 1) which is 6 ft wide x 3 ft 3 in. deep x 38 ft 6 in. long is complete with hood and threading device. The hood and double scrubbers following are exhausted by a 6000 cfm fan. Two 2000 ampere, 18 volt rectifiers are connected to the electrocleaner grids. Two double scrubbers are used to rinse the cleaning solution from the strip. These double scrubbers are equipped for both hot and cold water rinsing.

The acid pickle tank (Figure 2) which follows is 6 ft wide, 3 ft 9 in. deep and 70 ft 8 in. long, rubber and brick lined. The fumes from this tank and the following scrubbers are exhausted with a 10,000 cfm rubber lined fan through a fume scrubber which removes the acid fumes from the air. The deflector rolls are not below the acid level but are located so that the catenary of the strip between these rolls, which are 66 ft apart, permits the strip to be submerged in the acid. During shut down periods, an air operated arm lifts the middle of the strip out of the pickle acid, preventing the solution of the strip by the acid. It has been found desirable to place a support under this strip when the line is to be shut down for a considerable length of time. If the com-

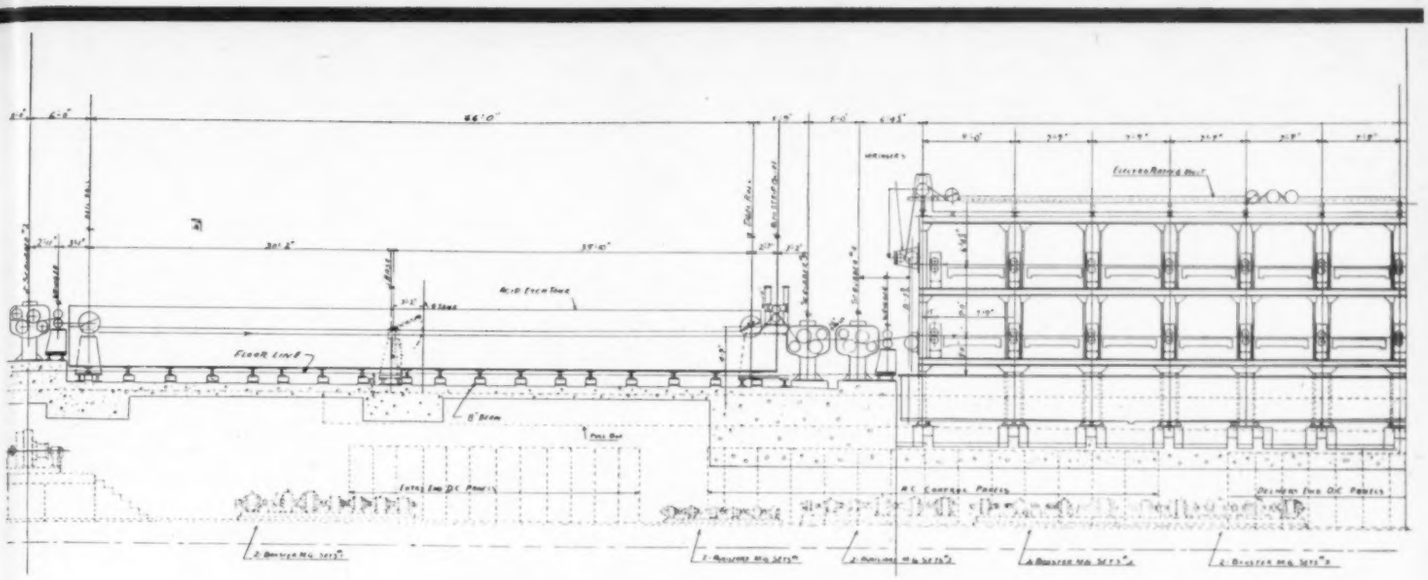


Figure 2 — Acid pickle tank, double scrubber and part of electroplating unit.

pressed air were to be shut off, the strip will not be lowered into the solution and dissolved.

An auto-strip guide unit is located at the delivery end of the pickler. This unit operates in response to photoelectric cells. When the edge of the strip cuts a beam of light due to the lateral shifting of the strip, a pair of rubber rolls in the auto-strip guide unit is tilted so that the strip is returned to the center of the pass line. Two double scrubbers then rinse the pickling solution from the surface of the strip before entering the plater.

The horizontal type plater was selected for its ease in threading, its lower voltage required for plating, its antifriction roll bearings mounted externally, its ease of plating different coating weights and even different metals on the two sides of the strip.

The plater consists of twenty-four plating cells, twelve in the first pass and twelve in the second pass, which have electrical contact rolls on each end of the cell and tin anodes in the cells below the strip. Tin is plated only on the under side of the strip. After the bottom side of the strip has been plated in the first pass the strip is carried up to the second pass where its direction is reversed, and the other side of the strip which is now the bottom side is similarly plated. Solution is pumped from the storage tank to the various cells in order to maintain the solution level against the bottom of the strip.

The anodes under the strip are maintained about the same width as the strip. When the anode-cathode distance becomes too great for efficient plating, the rectifier power is shut off, the solution pumped to the cell stopped, the cell drained, the bus bar disconnected, and the cell is moved laterally out from under the strip by an air cylinder. After anodes have been built up to the proper height, the cell is moved back into line and again put into service. This is done while the strip continues to be plated with the remaining cells.

After having both sides plated the strip then goes to the third pass of the plater where its direction is again reversed to the original direction. Here it goes through a reclaim tank and water sprays for rinsing. In the reclaim tank the valuable tinplating solution which adheres to the strip after leaving the plating cells is recovered and returned to the plating bath.

The halogen electrotinplating solution is used in the plating cells. As the name implies, the principal constituents of this plating solution are tin chlorides and fluorides. The tin content may be varied from 2 to 5 oz per gallon, depending upon the current density and strip speed. The bath is operated at a pH of about 2.7. Temperatures from 100 to 160 F can be used, although the optimum temperature is about 150 F. The higher temperatures are more desirable in order to obtain higher conductivity and to secure greater evaporation from the surface of the plating solution, since the amount of water which can be introduced on the strip to minimize drag-out will depend upon the amount of water evaporated. In any plating equipment conductivity is important in order to secure the desired current density with a minimum voltage. It has been found in actual operation that a current density of 185 amp per sq ft has been obtained with 6 volts in plating cells with an anode-cathode spacing of 1 in. Since this solution has not been adjusted to have the greatest conductivity, it is believed that a considerably higher current density can be reached with 6 volts at this anode-cathode spacing. This electroplating solution has been found to permit plating over a wide current density range. Depending upon the solution composition, it has been operated in various current density ranges between 50 and 500 amp per sq ft. In view of the fact that a solution cannot give the best electrodeposit over a wide range of current densities, equipment has been included in the electrical control which will permit the disconnecting of a predetermined number of plating cells during the slow speed operation necessary when welding. This permits the maintaining of high current

density plating, both during the welding operation as well as at the normal running speed. The total organic addition agent is about ¼ oz per gallon. It is believed that this low organic content of the plating bath may be an important factor in securing good soldering results of the finished plate.

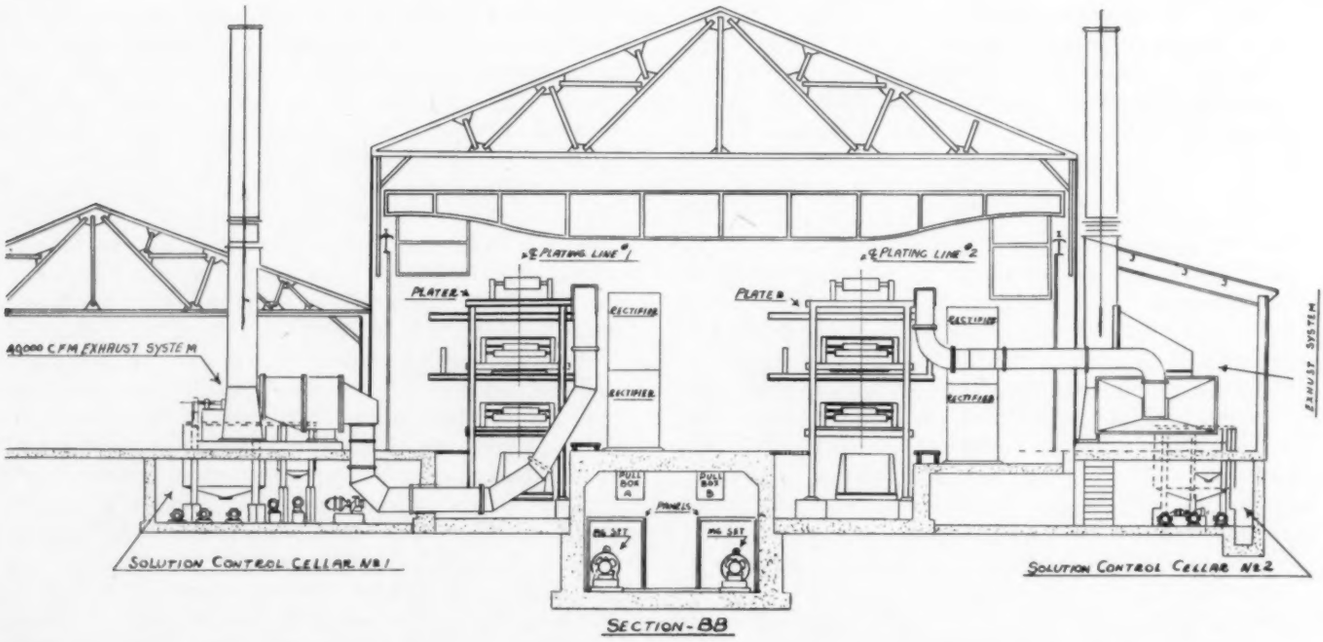
The cathode current efficiency is reported to us to be 97 per cent and higher while the anode current efficiency is reported to be 100 per cent. This difference in current efficiency helps to replace the tin lost in drag out. It is of the greatest importance that the cathode deposits be fine grained and suitable for melting. It has been found that this can be determined most easily by actual plating tests in which the plate is actually melted by electrical resistance or gas heat. In order for this melting test to be satisfactory it is essential that the melting be done in not more than ten seconds, otherwise excessive oxidation of the tin will give poor results. The anodes corrode very uniformly and no appreciable polarization has been found up to 500 amp per sq ft.

Two rubber lined mixing tanks, three pumps and three filter presses are used in the control room for preparing and maintaining the purity of the plating solution. Hoods and an exhaust fan are provided for exhausting the fumes from the plating cells. The capacity of this exhaust fan is 40,000 cfm. These fumes are scrubbed free of acid before being exhausted to the air.

The electric power for the twenty-four plating cells is furnished by twenty-four copper-copper oxide rectifiers (Figure 3), each being powered with 440 volt, 3 phase, 60 cycle a-c and furnishing 5000 amp at 6 volts d-c. The contact rolls carrying the current to the strip are made of steel with copper commutators on both ends. In making a decision to buy rectifiers instead of the conventional motor generator sets a number of factors were considered. Investigation showed that the first cost of rectifiers was about the same as the first cost of similar small sized motor generator sets and motor starters. The installation cost of rectifiers is much lower than that for motor generator sets, especially considering the space requirement under our conditions which would have made necessary a large increase in the size of the electrical substation in the basement. In considering the difference in electrical efficiency between motor generator sets and rectifiers it is believed that the higher maintenance cost of the rotating equipment will more than compensate for the difference of efficiency which has been reported.

The rectifiers are located two-high, in close proximity to the plating cells. The lower rectifiers are connected to the cells in the first pass, and the upper rectifiers are connected to the cells in the second pass, making a very short copper bus bar. All of the bus joints are silver plated. It is estimated that a saving of 55 tons of copper was made by the selection of rectifiers and their location. These rectifiers are designed so that they could be connected to deliver 5000 amp at 6 volts and can be externally reconnected to give 2500 amp at 12 volts. At present the rectifiers are connected to deliver 120,000 amp at 6 volts, which roughly corresponds to the current required for plating .5 lb per base box of tin at 1000 fpm. Should it be found necessary to increase the voltage from 6 to 12 volts in order to obtain the necessary current density for this high speed plating, provision has been made for the installation of a duplicate set of rectifiers which will give a total capacity of 120,000 amp at 12 volts. The rectifiers are located in cubicles and are completely sealed from the mill air. The air within the cubicle is circulated by two fans and is water-cooled with a fin type heat exchanger. A total of 250,000 amp are installed for the two electroplating

Figure 3 — Cross section at electroplating unit.



lines. This is the largest installation of low voltage rectifiers for electroplating in existence.

The plating current is controlled by means of saturable reactors in the 440 volt, 3 phase, a-c supplied to each rectifier. In order to control the current used in plating the top and bottom of the strip, the rectifiers for the first pass and for the second pass are connected to separate supply buses. The current to each of these buses goes through current transformers, the secondary of which is connected to a resistor. The a-c voltage drop across this resistor is rectified by a small copper oxide rectifier and is then compared with the voltage generated by a pilot generator running at strip speed in an electronic regulator that controls the excitation of the saturable reactors in the rectifiers. The regulator adjusts the field current of the generator to bring the reactors in the rectifiers to the proper value so that the two control voltages are exactly balanced. By this means it has been found possible to control the plating current so that its proportionality with line speed is maintained within reasonable limits. Means are also provided for this regulator to follow a taper bias if this is found desirable.

For the convenience of the operator, all of the individual plating cell controls, meters, and the totalizing meters for the first and second passes are located at the center of the plater. The controls for the second pass are located on the balcony of the plater. All of the meters, however, are located in a position which enables an observer either at the first pass or at the second pass to read all the meters for both passes. This centralization of the plating cell control is especially convenient when the placing of newly built-up anodes on the line makes it necessary to readjust the plating cells in order that the load will be balanced.

In order to totalize the current for the indicating meters a special circuit has been used in which the indicating meter is connected to a bus bar to which all of the rectifier shunts are connected in parallel with leads of exactly the same resistance. For a simple illustration, Figure 4 shows rectifier shunts No. 1 and No. 2, each generating 100 mv and having a resistance of 0.1 ohms, connected through the common bus ACE and BDF to an ammeter A whose resistance is 10 ohms. Kirchoff's law states that in any closed portion of an electrical circuit, the emf applied to the circuit is equal to the algebraic sum of the IR drops in the circuit. Following the circuit for shunt No. 1 and the ammeter (ABFE) the IR drops will be:

$$100-0.1\ I_1-10\ I_A=0, \text{ or } I_1=1000-100\ I_A \quad (1)$$

Similarly for shunt No. 2 and the ammeter (CDFE) the IR drops will be:

$$100-0.1\ I_2-10\ I_A=0, \text{ or } I_2=1000-100\ I_A \quad (2)$$

$$\text{Since } I_A=I_1+I_2 \text{ and} \quad (3)$$

$$I_1=I_2 \quad (4)$$

$$I_A=2(1000-100\ I_A) \quad (5)$$

$$201\ I_A=2000 \quad (6)$$

$$I_A=\frac{2000}{201} \quad (7)$$

This gives the current value registered on the ammeter. When one of the rectifiers is shut off, the conditions are shown in Figure 5. Note that shunt No. 1 has 0 mv. Again applying Kirchoff's law on shunt No. 1 (ABFE), the current in the shunt is now opposite in direction to the former current flow and this IR drop reverses its sign as follows:

$$0+0.1\ I_1-10\ I_A=0, \text{ or } I_1=100\ I_A \quad (8)$$

and for shunt No. 2 (CDFE),

$$100-0.1\ I_2-10\ I_A=0, \text{ or } I_2=1000-100\ I_A \quad (9)$$

$$\text{Since } I_2=I_1+I_A, \text{ then } I_2=100\ I_A+I_A \quad (10)$$

Equating (9) and (10),

$$100\ I_A+I_A=1000-100\ I_A \quad (11)$$

$$201\ I_A=1000 \quad (12)$$

$$I_A=\frac{1000}{201} \quad (13)$$

With only one rectifier operating, the current for ammeter deflection (1000÷201) is only half as great as

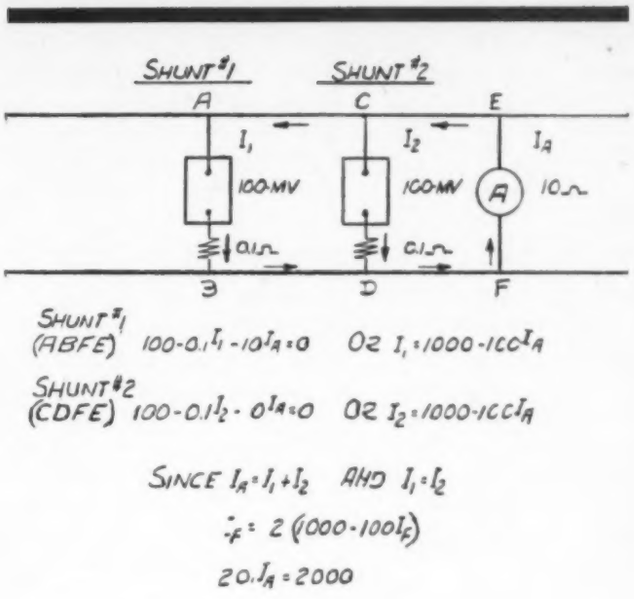
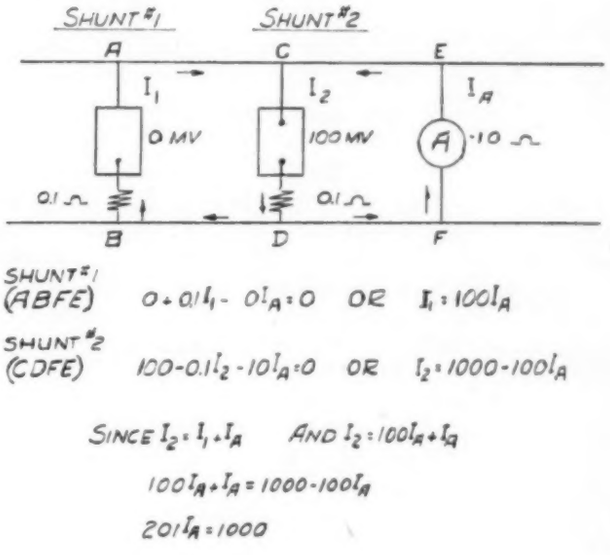


Figure 4 — Shunt connections for totalizing electroplating current with two rectifiers energized.

▲

Figure 5 — Shunt connections for totalizing the electroplating current with one rectifier energized and one deenergized.



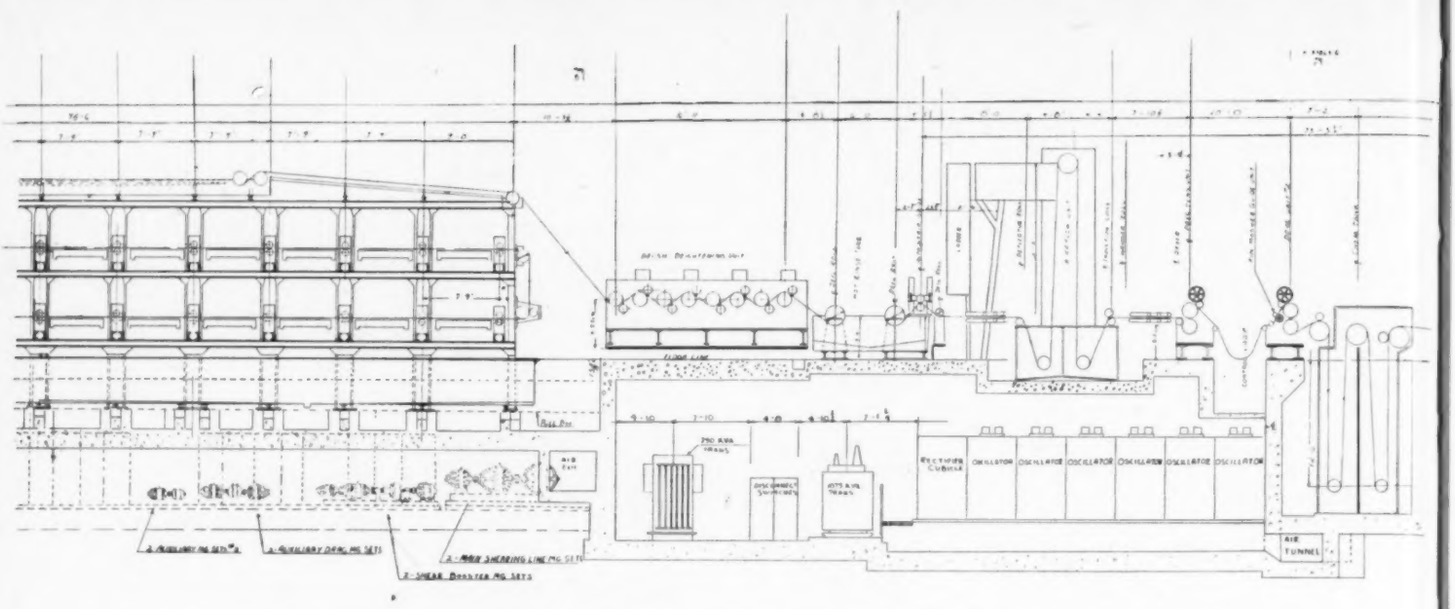


Figure 6 — End of electroplating unit and finishing zone, including flow brightener control basement.

when both rectifiers were operating (2000÷201) and therefore the scale deflection will be half as great. This same line of reasoning may be used for any number of rectifiers.

FINISHING ZONE

On leaving the plater the strip now enters the finishing zone (Figure 6) where the tin coating is given the necessary treatments to make it suitable for its intended use. A brush brightener is being installed in one line in order to brighten plate which may have a coating weight too light for melting. This brush brightener consists of eight nickel-silver brushes with means for precision adjustment and honing of the brush surfaces.

The next unit is a rubber lined hot rinse tank which has on its delivery end a second automatic guide unit for centering the strip, similar in design to the unit at the end of the pickle tank.

The strip now enters the flow brightener in which the tin coating is melted. The melting equipment consists of six 200 kw heater coils and the necessary equipment for controlling and converting 2300 volt, 60 cycle, a-c power to 200,000 cycle high frequency current suitable for use in the heater coils (Figure 7).

The 2300 volts of power is brought from the flow brightener unit substation and main breaker through saturable reactors to a disconnecting cubicle. These saturable reactors are controlled by a separate motor generator set. The power is then transformed from 2300 volt to 12,600 volt which is fed into the mercury vapor rectifier cubicle. The output of the rectifier which is 17,000 volt d-c is fed into the oscillator which is capacity coupled to the tank coil. This oscillator circuit produces the high frequency current used in the heater coils. The heater coils and high frequency generating equipment are cooled by distilled water which is recirculated through a nonferrous heat exchanger. The purity of this distilled water must be maintained in order to prevent power losses of the high frequency current through the water column. This installation is designed to melt tin on steel strip .010 in. thick by 30 in. wide at a speed of 1000 fpm. For comparison with ordinary radio stations the power for each line is twenty-four times as great as the normal power used by the most powerful broadcasting stations. This gives a total power in the flow brightening equipment the equivalent of 48 such stations for the two lines. After melting, the strip is quenched in hot water whose temperature is maintained constant with steam coils and cold water heat exchangers.

After drying the strip goes through the precision tension unit, similar in design to the No. 1 drag unit, pulling against the No. 1 drag unit at the first looping pit. This tension unit is powered by 125 hp d-c variable speed motor and provides the basic speed control for the line. Following a looping pit, equipped with photocontrols to limit the travel of the loop, the strip enters the No. 2 drag unit through fin masher guides. This drag unit provides the back-tension for a part of the finishing zone and the recoiling zone. The strip is then given a chemical treatment and rinsed. In this tank the strip travels vertically about twelve feet having two passes in each of these tanks. This chemical treatment is necessary to provide satisfactory enamel adhesion for the sanitary enamels which are customarily used with electrotinplate in canning food products.

On leaving the chemical treatment rinse tank, the strip passes through the lap detector, whose function is described below, and into the emulsion oiling tank. This unit consists of a two compartment tank in which the strip is dipped in a tank of emulsified oil in water, passes through a wringer roll, then is dipped in a rinse tank and again passes through wringer rolls and is dried. This completes the finishing operations.

RECOILING ZONE

At elevated speeds, it is necessary to coil the electrotinplated strip and to cut it to length as a separate operation. When operating in this manner, the strip is coiled on either of two reels (Figure 10). When a weld passes through the lap detector, it sets in motion a series of operations which are controlled automatically as follows: the pusher pinch roll is started and brought up to line speed, then a hydraulic cylinder pushes this pair of rolls together; the snip shear cuts the strip on the fly just behind the weld, and directs the entering end of the strip into the proper reel chute; the strip is then started on the empty reel by a vertical belt wrapper; the loaded reel is stopped, and the hydraulic pressure released on the pusher pinch roll. It has been claimed that this is being done at speeds in excess of 700 fpm.

If the plating line speed is within the range of the cutting line speed, the strip is threaded through the No. 2 reel chute, over the reel, and through the shear tension puller. This tension unit pulls the strip from the No. 2 drag unit and delivers it into a loop ahead of the cutting line. This shear tension unit and the reels mentioned above are powered with 75 hp d-c motors.

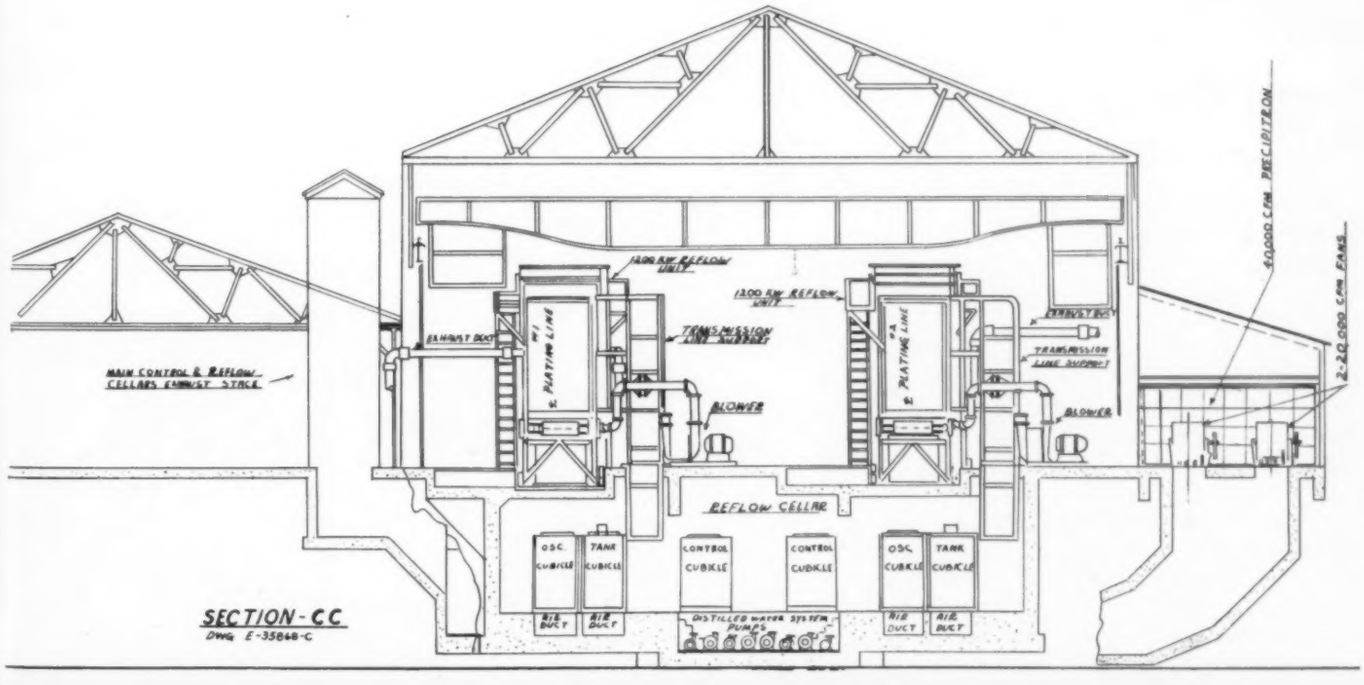
SHEARING ZONE

When operating in tandem with the electrotinplating line, a loop is formed between the shear tension unit and the pinhole detector unit of the shearing line. This loop is equipped with a thyratron loop control. The pin hole detector and magnetic gauge, either of which operates the gate in the classifier, are mounted in the same unit. Due to the softness of the tin coating the conventional continuous thickness gauge, equipped with rotating wheels has been found to be unsatisfactory. In order to hold the strip gauge to the close tolerances required by tin plate users, a special gauge has been used. In operation the strip is wrapped around a steel drum and a magnetic coil is held in close proximity to the steel strip at a position determined by a roll riding on the steel drum. As the strip thickness varies, the air gap between the strip and magnetic face will vary and this variation is detected and indicated on a meter. Electrotinplate which is off-gauge will be thrown out along with the sheets which the pinhole detector has found to be imperfect.

Next is the synchronized rotary flying shear driven with a 50 hp d-c motor. Although this shear has been operated at speeds up to 700 fpm, its most successful operation is at speeds of 600 fpm and lower. After shearing, the sheets which are off-gauge or have pin holes and other defects are put into the off-gauge piler as mentioned above. The good sheets are piled in the electrotinplate sheet piler. When the line is completed, 1120 sheets suitable for the customer will be counted, piled on a platform at the classifier, and shipped directly to the customer. In addition to the off-gauge piler a third piler may be installed in the future, into which the questionable plate, to be hand assorted, will be diverted by the quality observer who will inspect the plate as it enters the cutting line.

An uncoiler is provided for handling coils wound on the reels mentioned above. When operating the electrotinning line above 600 fpm, a third complete shearing line has been installed adjacent to the tandem shearing lines to take the overflow in production when it becomes necessary.

Figure 7 — Cross section at the flow brightener unit showing flow brightener control basement and its ventilating system.



FOGGY PLATE

A considerable amount of discussion has centered around the elimination of so-called "fog" or "smog" on electrotinplate. This fog is a cloudy appearance or may be any factor which prevents the melted tin deposit from having a brilliant luster. One of the reasons it is so difficult to locate the source of this trouble is the fact that it may result from almost any operation in the line. To start with, it is necessary to have a good surface on the steel delivered to the line. If the surface is too rough or has a variation in surface appearance, the melted tin will not be uniform and reflective. Following down the pass line from the uncoiler, if the electrocleaning operation is not complete and there is any oil remaining on the surface of the strip, the oily parts will be dull gray after brightening. In like manner overpickling roughens the surface and causes a dull appearance. Among the most important sources of fog is the plating solution itself. Certain compositions of plating solutions, in the proper current density ranges, produce brilliant plate on melting, whereas the same solution outside of the indicated current density range will produce dull plate. It is evident, therefore, that all of the factors controlling the quality of the plate, such as temperature, pH, current density, composition, and absence of impurities, etc., must be controlled in order to secure a plate which will flow-brighten satisfactorily. It is important to remove the tin plating solution from the surface of the strip without the tin hydrolyzing. The manner by which this is done will vary according to the solution which is used. In most of the electrotinning lines the composition of the solution in the reclaim tank can be adjusted so that the tin will not be hydrolyzed in this tank and in subsequent rinsing operations. It is believed that more fogging results from improper plating solution control and hydrolyzed tin salts or improper rinsing than from any other factors. It is important that the rinse tank and the quench tank after flow brightening be provided with clean water. In certain cases the flow brightener itself may be the controlling factor and the strip temperature, quench water temperature, and the time between melting and quenching may have a large effect on the finished surface. From the numerous factors which may cause foggy plate, it is no wonder that this defect would be troublesome in starting up the various electrotinning lines.

FUTURE OF STRIP ELECTROPLATING

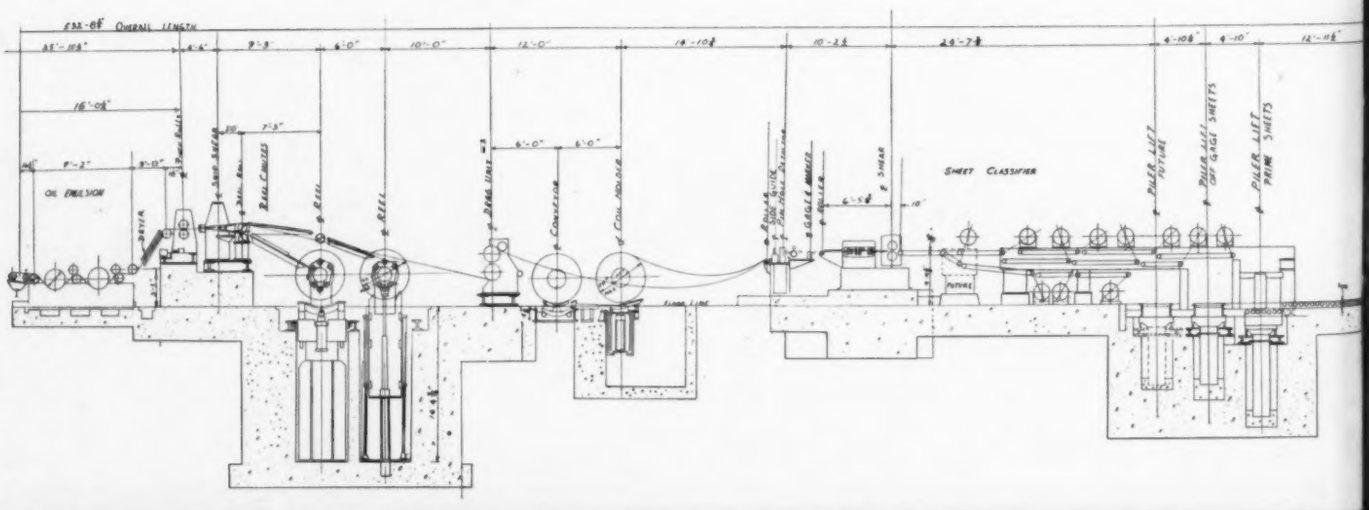
There are now 29 electrotinning lines with an estimated total production of between 40,000,000 and 50,000,000 base boxes yearly. This is about half of the tin plate used when the tin plate industry was at its peak production. This electrotinplate is being used today for food pack including vegetables, meat products and fish, for milk cans, and for closures, etc. After the war when general line cans can be made again, they will undoubtedly be produced from electrotinplate. In fact it is believed that various grades of electrotinplate will be developed until they will be suitable for practically all of the ordinary uses for which coke tin plate was formerly used.

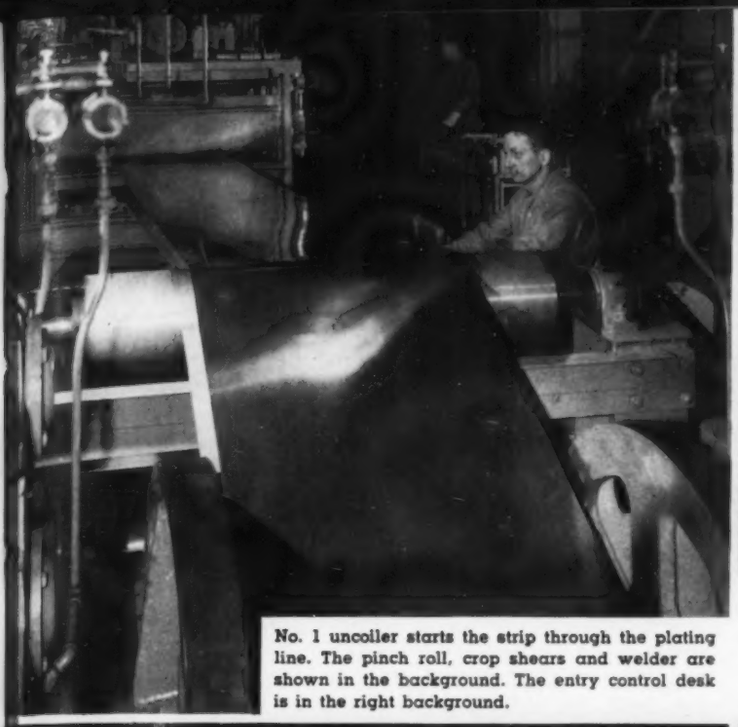
In traveling along the electrotinning line, it will have been seen that every part of the operation has been directed toward the production of the best quality of plate — the best of base metal surfaces, electrocleaned, pickled, plated under carefully controlled conditions and finished with the proper treatment to suit customers needs. The result is a lustrous sheet with excellent enamel adhesion, solderability, corrosion resistance and handling properties.

The equipment is flexible enough to produce light weight tin coatings (0.5 lb per base box) at high speeds, yet has enough plating capacity to produce the heavier coating weights contemplated at present, at the normal operating speed of the line. With these advantages of quality of product, flexibility of operation, and high tonnage production, it is not unreasonable to assume that low operating costs will be attainable.

Electrotinning is leading the way. Other strip steel electroplated products are bound to follow in its wake.

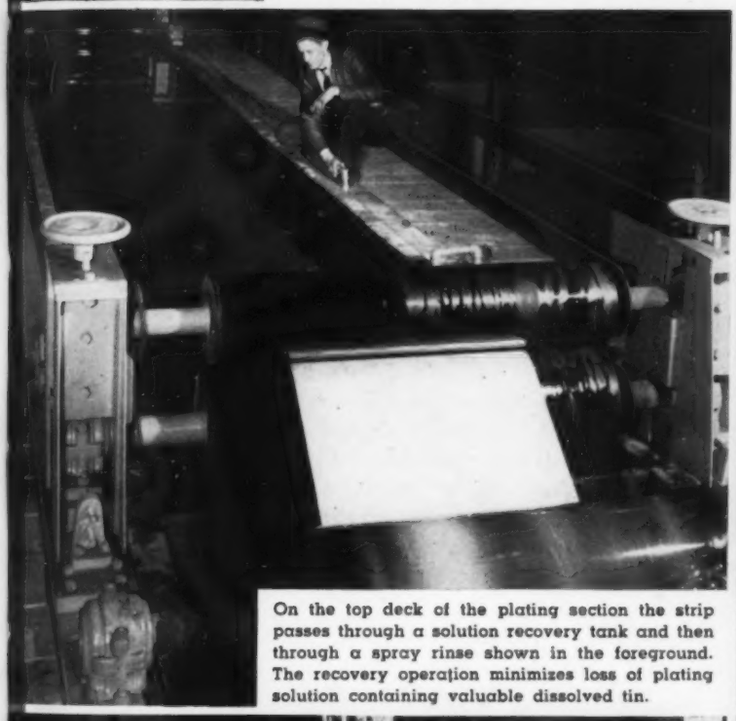
Figure 8 — Recoiling and shearing zones.



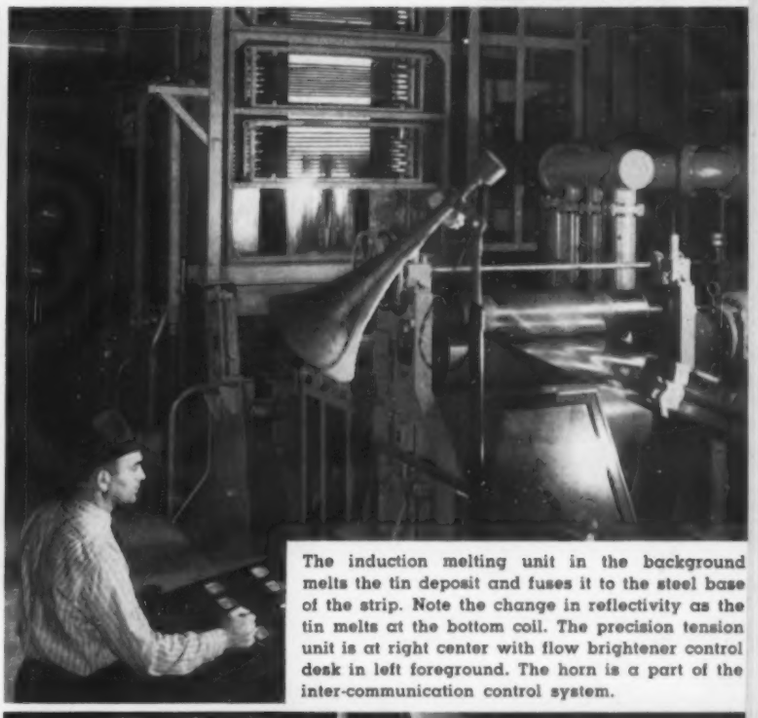


No. 1 uncoiler starts the strip through the plating line. The pinch roll, crop shears and welder are shown in the background. The entry control desk is in the right background.

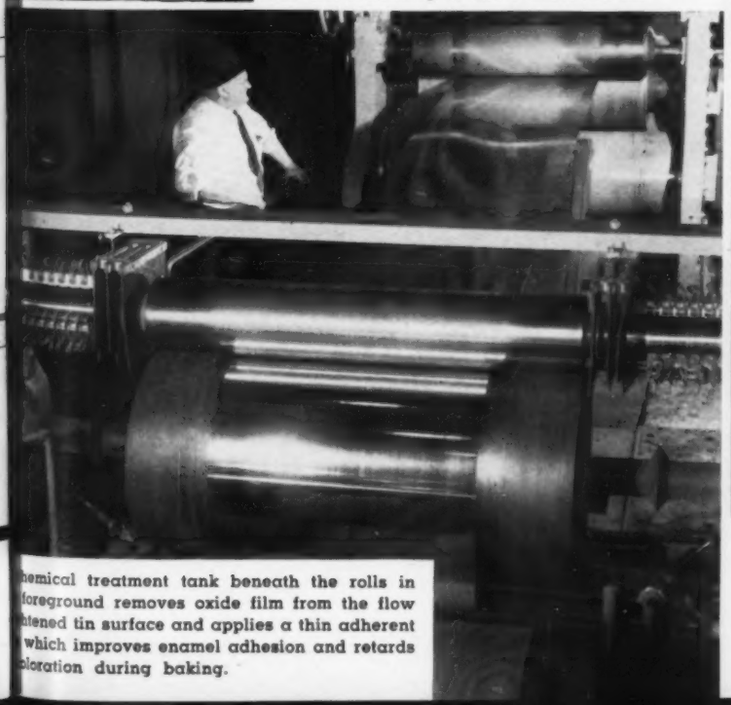
In these plating cells the strip runs between contact rolls with the vertical bus bar, connecting to the anodes, shown in the right foreground. Each cell adds a portion of the coating to one side of the strip only. The other side is plated in cells on the upper deck.



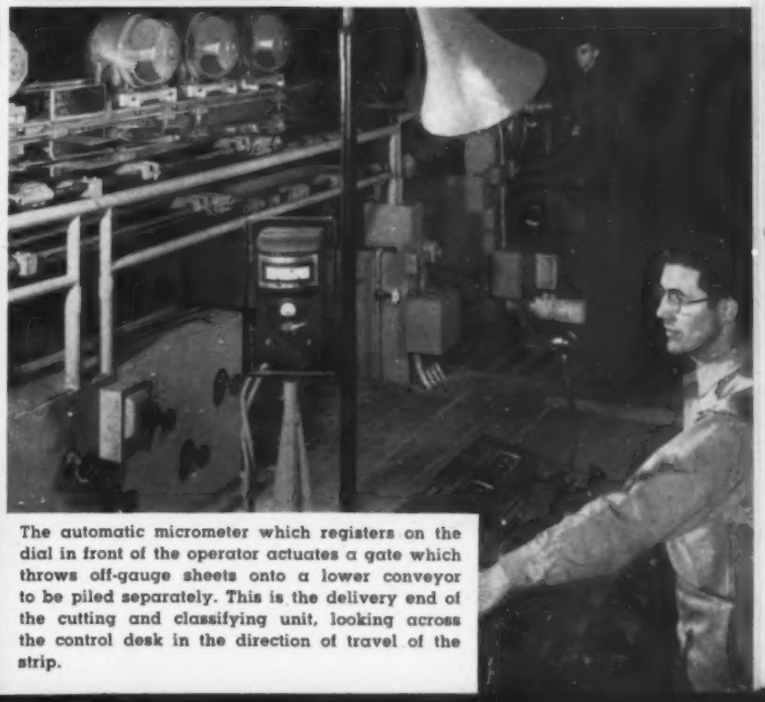
On the top deck of the plating section the strip passes through a solution recovery tank and then through a spray rinse shown in the foreground. The recovery operation minimizes loss of plating solution containing valuable dissolved tin.



The induction melting unit in the background melts the tin deposit and fuses it to the steel base of the strip. Note the change in reflectivity as the tin melts at the bottom coil. The precision tension unit is at right center with flow brightener control desk in left foreground. The horn is a part of the inter-communication control system.



hemical treatment tank beneath the rolls in foreground removes oxide film from the flow htened tin surface and applies a thin adherent which improves enamel adhesion and retards loration during baking.



The automatic micrometer which registers on the dial in front of the operator actuates a gate which throws off-gauge sheets onto a lower conveyor to be piled separately. This is the delivery end of the cutting and classifying unit, looking across the control desk in the direction of travel of the strip.

DISCUSSION

PRESENTED BY

E. W. HOPPER, Superintendent Tin Plate and Electro-chemical Division, Crucible Steel Company of America, Midland, Pennsylvania
G. E. STOLTZ, Electrical Engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania
H. P. MUNGER, Superintendent of Electroplating, Republic Steel Corporation, Cleveland, Ohio

E. W. HOPPER: I want to congratulate Mr. Munger on the very fine description of the equipment and the line they have installed, and also the operating characteristics.

It looks as though you have now heard a description of the perfect line, perfectly engineered, and with a perfect plating solution, and you will now find a perfect tinplate.

I do think the line has been well engineered from what we have heard. It looks as though they paid a whole lot of attention to details, and I certainly will be interested in finding out in the next couple of years whether Mr. Munger has any recommendations as to changes that might be necessary to further improve the line.

There are several things I would like to ask. What is the uniformity of coating across the width of the strip? Is it uniform, or how nearly uniform from edge to edge?

Second, have they noticed any great amount of sludge formation in the bath?

I don't know whether Mr. Munger has any information as yet on lacquer adhesion, due to the short time the tinplate has been on the market.

G. E. STOLTZ: I too want to say that this has been a very interesting paper. I think Mr. Munger has covered this subject very well and very completely, and the only thing I could add would be to probably describe some of the electrical features that are used on this line.

The electrical equipment used on this type of line divides itself rather naturally into three classes, the first being the driving equipment, which consists of the motors and the motor generator sets and their controls that drive the various rolls and other devices. The second is the electrical equipment that is used to provide the plating current and its control, and the third is the brightening equipment that is used to flow the tin after it has been electrically deposited.

On this type line, as Mr. Munger has explained, speeds may vary from a thousand to a hundred feet per minute, or to such other creeping speed as may be desired. This is necessary due to the fact that the loop that is used during the welding operation is rather short, and when the coils are welded together, the line must be brought down to a very slow speed. There are in the neighborhood of fifty direct current motors used to drive a line of this type, in addition to certain a-c motors. These motors vary in horsepower from one to 125.

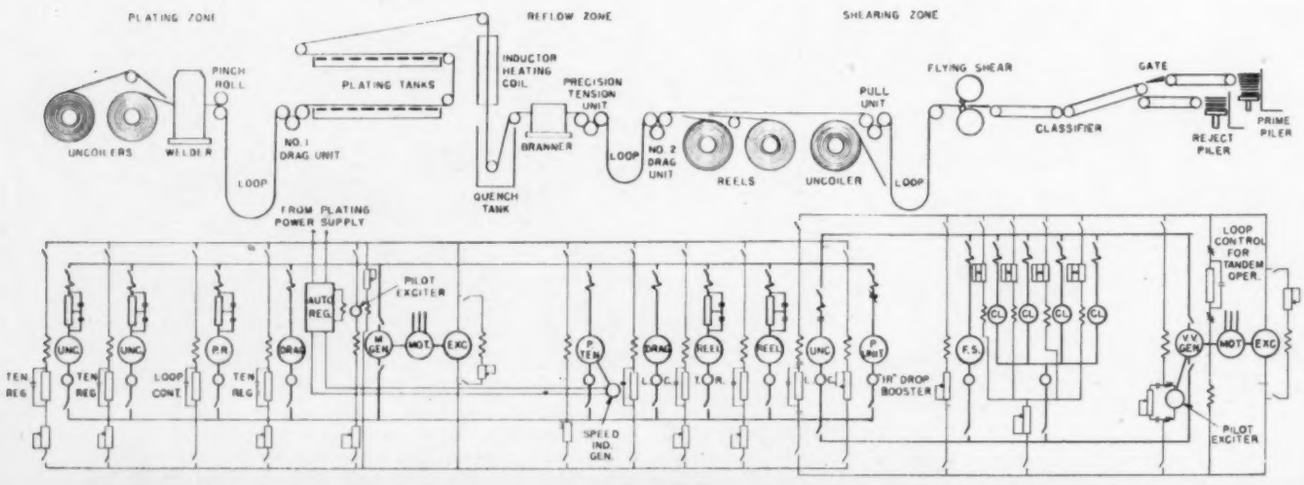
Naturally their loads and characteristics are not the same, still we are required to synchronize all of these operations over this entire speed range. To assist in doing this, we provide one motor generator set that supplies power to a bus from which these motors operate, and the only exception to that would be where sections of the line may be operated separately, as described by Mr. Munger. There are times when the strip is coiled, and the shearing line and classifier are operated separately, so that two motor generators are provided for this particular line that may be operated either separately or in parallel as a unit.

We use a great deal of care in designing these motors so that they will synchronize with each other once the speed is set to the value desired, and very good results are obtained when operating at normal speeds. However at very low speeds it is necessary to use an auxiliary machine to make the motors continue in synchronism.

To accomplish this, what is known as an IR drop booster is placed in series with each of the drive motors, and this booster is connected so that its field is energized as a shunt off the interpole winding of the main motor. If an individual motor is carrying no load, there is not current passing through this winding, and no voltage is obtained from the armature of the booster.

On the other hand, as the main motor takes load, the booster increases its voltage and offsets the IR drop, so that whether the line is operating at the top speed or bottom, the motors synchronize uniformly.

Figure 1 — Simplified diagram of electrical equipment driving the electrolytic tinning line.



The second class of apparatus is the equipment used to provide the plating current. In this instance, on Mr. Munger's lines, rectox units have been used, and they are mounted, two of them in each cell so that they can be connected for 2500 ampere separate units, at six volts, in parallel for 5000 amperes, six volts, or two in a series for 12 volts.

At the present time they are operating as six-volt, 5000 ampere units. Mr. Munger has mentioned how any unit can be disconnected by means of a contactor.

The control of the amount of direct current applied to an anode is accomplished by means of what is called a saturable core reactor. This is controlled by an electronic regulator which balances voltage on a magneto, which is a measure of speed, against the amount of current that flows into the bus.

Figure 2 is a view of the apparatus as mounted in cubicles. At the top is a blower which delivers air down the side of this unit. The air then comes up through a heat exchanger which cools the air. A rectox assembly is shown on each side with the transformers in the center, making a compact unit. The cubicles are mounted alongside the line, one above the other, the lower row delivering the current to the lower unit of the line, and the upper units supplying the current for the upper part of the line.

The third type of apparatus used on this line is that required to brighten the tinplate. This is induction equipment, the heating being accomplished by a series of coils wound around the strip. High frequency current is generated in the steel strip.

The electrical apparatus consists of a circuit breaker on any commercial frequency line, an induction regulator or saturable core reactor which will vary the power input, regardless of whether the gauge or the speed varies, then a rectifier with transformer which supplies direct current for oscilators.

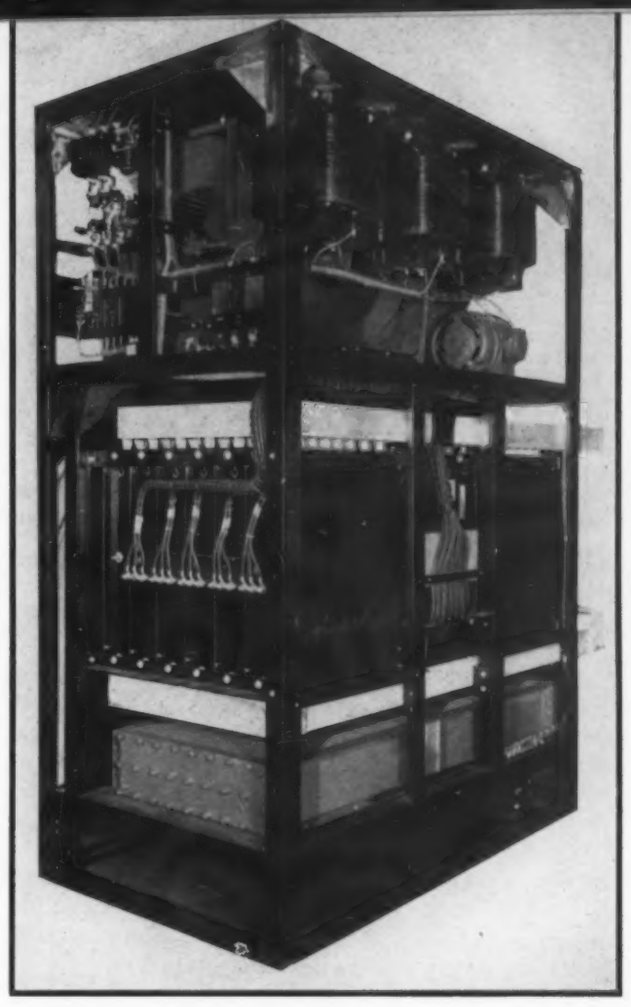
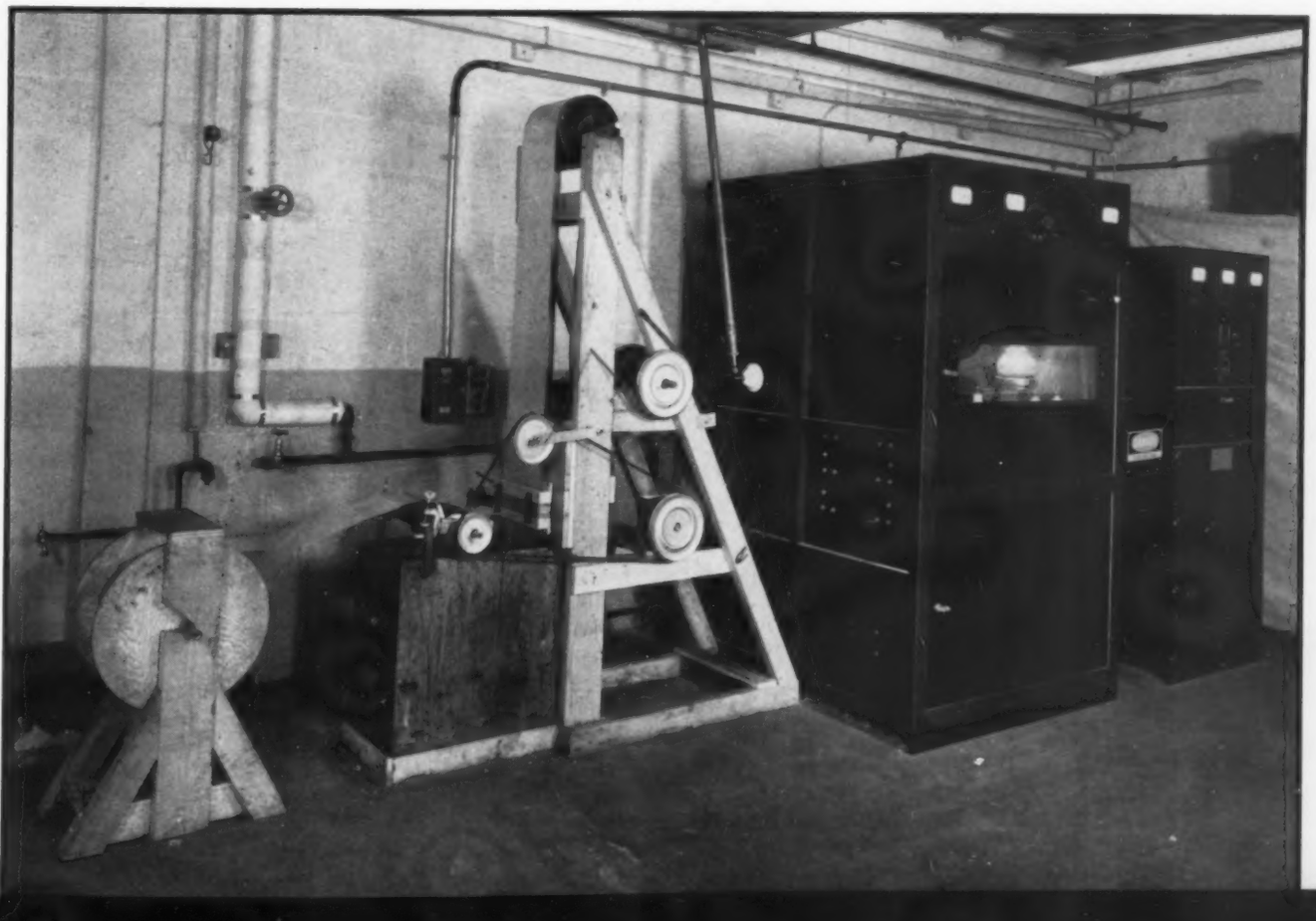


Figure 2 — Rectifier unit with covers removed.

▲

Figure 3 — Experimental unit for inductively heating tinplate for reflowing.



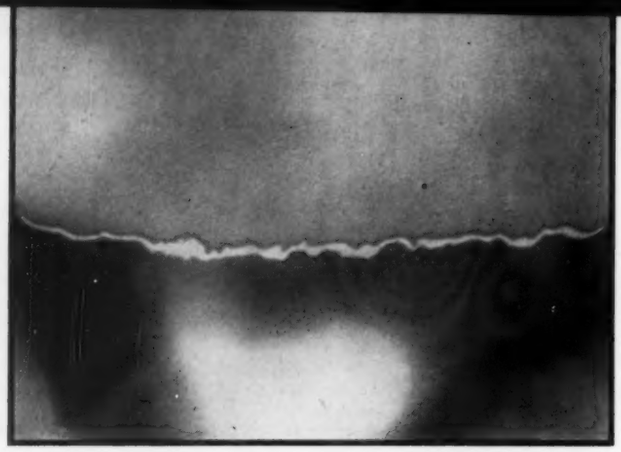


Figure 4 — Showing matte surface (top) coming from plating unit, with inductively reflowed surface below the flow line.

An illustration of how the strip is heated is shown in Figure 3 which is an experimental unit that inductively heated tin at forty feet per minute. The tin plate was carried up over the top of the frame and down through the inductor heating coil which consists of six turns of hollow copper tubing. The length of this inductor coil along the travel of the strip is two inches, so that the heat was generated in that length of two inches of strip as it passed through the coil.

The temperature was raised from atmospheric temperature to 452 F, or slightly above that required to flow the strip.

An indication of whether or not the strip is being heated uniformly is shown by the character of the flow line across the width of the strip. It is a little difficult to get a photograph that distinguishes those two surfaces, but the surface is illustrated in Figure 4. The upper surface is the matte surface as it comes from the plating tank, and the lower section is the brightened surface. The flow line is a fairly straight line and represents graphically how uniformly the heat is being generated in the strip.

One of the problems was to determine when we had the proper temperature. If the heat is insufficient, spots are not brightened, and if too much, the tendency is to oxidize the tin surface. It is difficult to measure this temperature by any optical means. Finally a system was developed using light sources and photoelectric cells; one would play on the matte diffused surface and the other would play on the bright mirror surface.

As this strip passes through a heater coil it is raised in temperature uniformly from the entry of the coil until it leaves the coil, and ideally we would like to have the tin flow just as it is leaving the coil. This is not practical, due to the fact that the gauge of the strip may vary, and there will be spots that are not flowed. For this reason it is our custom to hold this flow line at some point between ninety and ninety-five per cent of the distance through the length of the coil. This results in from five to ten per cent greater temperature than 452 F. That is something that can be controlled and held rather accurately, regardless of the gauge or the speed of the strip, or the fact that voltage on the supply line may vary.

The apparatus used to do that is illustrated in Figure 5, with two light sources, one of which plays on the bright strip, and the other on the matte strip. With the lower light source playing on the bright strip at a direction vertical from the surface, the light is reflected back into the source, and its particular photocell receives no light.

The upper light plays on the matte surface and it will throw the light at all angles around the source of light, and its photocell will receive light. If the flow line should move up, and the bright surface gets up to this upper light source, the light will be thrown back into the source, and this cell will receive no light.

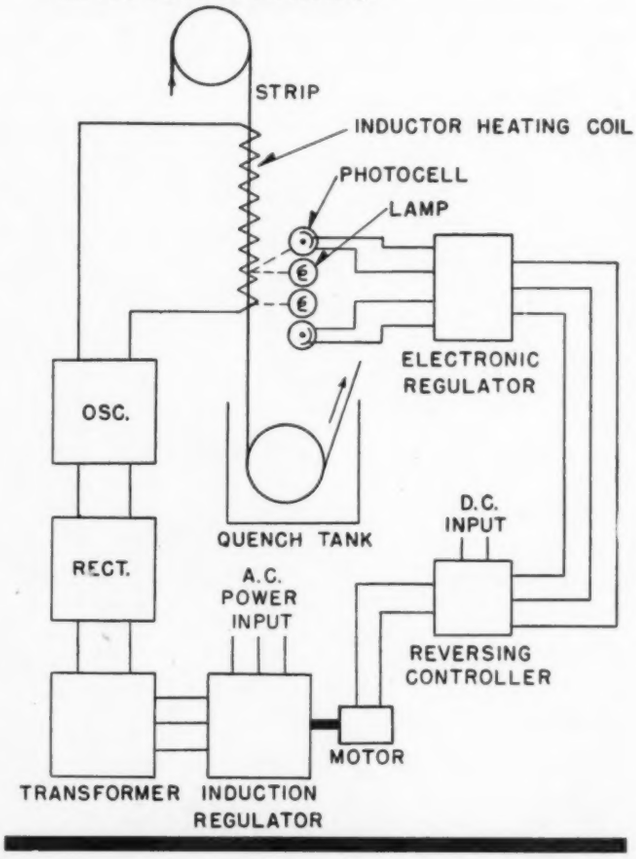
On the other hand, when the matte surface gets down to the lower source of light, it will reflect light to its photocell. In each case by means of relays and a regulator or saturable core reactor, the power input will be either increased or decreased and flow line brought back between those two light beams, thus insuring the temperature that is desired.

H. P. MUNGER: In answer to Mr. Hopper's questions, we find that the normal coating weight variation from one edge of the strip to the other is not more than .000003 in. and usually less than this value, showing a very uniform coating.

There is a small amount of sludge formation in the operation of this electrolyte. The sludge has presented no problem so far, and we have not removed the small amount of sludge which has accumulated in the plater storage tank.

Our laboratory tests have shown excellent enamel adhesion both for inside and outside enamels. Tests are being run in our customers' laboratory and the results of these tests are not available at the present time.

Figure 5 — Sketch showing automatic control of temperature for fusion of tin coating.



Pitch AS AN Open Hearth Fuel

. . . . properly handled, pitch makes an excellent fuel for open hearth furnaces . . . . tests show increased production, but at the expense of slightly higher heat requirement . . . .

by J. F. Wilbur, SUPERINTENDENT
STEAM AND COMBUSTION DEPARTMENT
BETHLEHEM STEEL COMPANY
JOHNSTOWN, PENNSYLVANIA

▲ IN April 1934 we started using a small amount of liquid pitch as fuel in the open hearth furnaces of Bethlehem Steel Company at Johnstown, Pennsylvania. From that small beginning we have developed to the point where today about 30 per cent of our open hearth fuel is pitch. In those early days, numerous difficulties were encountered in transporting, heating, and burning the pitch. We shall strive to show how these difficulties were overcome and our system developed.

At present the use of pitch as a fuel in a well-planned open hearth system has advantages over oil. It is just as good if not a better fuel than oil. As a matter of fact many first helpers prefer pitch.

The pitch is a by-product of the coke plant and does not need to be shipped over war-crowded railroads. During these times of emergency and with the necessity of saving fuel oil, every effort should be made to use pitch wherever possible and to get the best results from it.

PITCH MANUFACTURE

The substance called "pitch" is a composite of numerous complex chemical compounds the relative gravities of which change as the coal-tar and distilling temperatures vary. Perhaps the simplest definition of pitch would be: "The residue after certain tar-acid oils have been distilled off." Pitch is graded under a variety of names: road, soft, hard, semi-pitch and top tar. The basic difference among these is the distillation temperature. Whenever this temperature is increased the melting point is raised and the pitch becomes harder.

Pitch will vary in analysis from plant to plant as the coal tar composition and distilling temperatures change. Typical pitch analysis from each of our two coke plants is shown in Table I.

We consider 120 F the limit for the melting point of pitch that is to be used as a liquid fuel.

The pitch for the open hearth is manufactured in coke plants A and B. At plant A a continuous-type tar still is in operation as shown in Figure 1.

The coal tar from the by-product plant is dehydrated and pumped into two kettles. The tar flow to each kettle is regulated by a throttling valve. Each kettle is heated by under-fired coke gas burners and agitated by jets of superheated steam. The tar in the kettles is maintained at a controlled temperature of 536 F. Creosote and tar-acid oils are distilled off and separated in a fractionating column and condenser. The top tar or pitch is continuously removed from the two kettles and passed through a heat exchanger where the incoming coal tar is heated. The pitch is stored in two 19,000 gallon insulated storage tanks to await shipment by a pipe line to the open hearth.

At coke plant B the pitch is manufactured in a Barrett direct tar still. The coal tar is heated and distilled by direct contact with the hot coke-oven gas from seven ovens. The tar is heated by heat exchangers and then introduced to the main heating chamber. After heating to 410 F for a period of time the tar residue becomes pitch and is continuously weired off to a 34,000 gallon insullated storage tank. Here it is loaded into railroad tank cars for shipment to the open hearth. The hot coke gases, leaving the heating chamber, carry with them the tar-acid oils. The oils condense as the gas is cooled by the heat exchangers and water cooled condensers, and are collected in tanks. The coke gas then goes to the by-product plant.

Presented before A. I. S. E. ANNUAL CONVENTION, Pittsburgh, Pa., Sept. 28-30, 1943

At both coke plants the acid oils amount to approximately 20 per cent of the tar charged, leaving 80 per cent as pitch.

TRANSPORTATION OF PITCH

The distribution and transportation of the pitch from the coke plants to the open hearth is shown in Figure 2.

At present about 1,200,000 gallons of pitch per month are burned in the open hearth furnaces. Coke plant A supplies about 70 per cent of the pitch requirement by means of a 4 in. welded pipe line, approximately 2800 feet long. The remaining 30 per cent of the pitch is brought from coke plant B, about 6 miles away, in insulated tank cars.

At coke plant A the pitch is pumped from the tar still into two 19,000 gallon insulated storage tanks. As the pitch is needed, these tanks are emptied and pumped into a 4 in. line to the open hearth. Whenever the open hearth has received sufficient pitch, the pumps at the coke plant are stopped and the line is blown out with steam. At one time compressed air was tried instead of steam. This system was discontinued as a result of the pitch freezing.

A 1 in. steam line has been installed next to the pipe line for warming purposes. Both lines are covered together with heavy horse hair felt and tar paper. Initial pitch temperature at the coke plant is about 320 F and the final temperature of the pitch at the open hearth about 280 F. The line is inspected once a month to locate poor insulation which would permit freezing. At one time, due to faulty insulation, the pitch in the entire 2800 feet of line froze. Holes had to be cut in the line and pitch melted out with steam lances.

The pitch from plant B is loaded into railroad tank cars, which are insulated with 3 in. of rockwool and sheet metal. The cars are hauled about 6 miles and unloaded into the open hearth storage tanks. Tests have been made on these cars in the winter and it was found that the pitch temperature dropped only about 10 F in 24 hours. However, each car is equipped with a steam coil to heat the pitch if it becomes sluggish.

TABLE I

Typical Analysis of Pitch at the Johnstown Plant of Bethlehem Steel Company

	Coke plant A	Coke plant B
Specific gravity, 60 F	1.241	1.218
Melting point (ring and ball method)	95.0 F	98.6 F
Gross Btu per lb (calculated)	16,200	16,300
Gross Btu per gal (calculated)	167,600	166,000
Viscosity at 212 F		
Engler	215 sec	180 sec
Saybolt Furol	736 sec	617 sec
Ultimate analysis	Per cent	Per cent
Carbon	89.76	88.94
Hydrogen	4.94	5.38
Nitrogen	1.05	1.06
Sulphur	.69	.65
Ash	.50	.60
Oxygen	2.98	3.37
Total	100.00	100.00
Free carbon (insoluble in benzol)	10.82	6.65

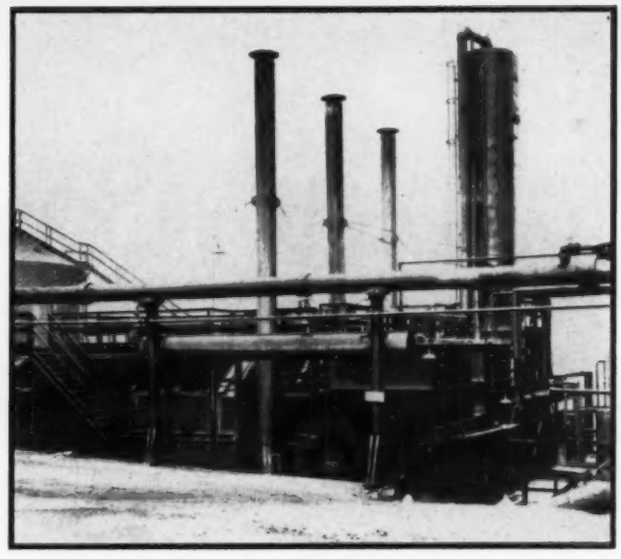


Figure 1 — Continuous type tar still.

The pitch received from either plant A or B is stored in two 13,400 gallon insulated storage tanks at the open hearth. The temperature in these tanks is maintained at 280 to 300 F by steam coils. With these tanks a 12 hour supply of pitch can be kept on hand. This supply is sufficient to carry the open hearth over any short delays in shipments.

The pitch contains some fine coke-like material which settles out in the storage tanks and forms a hard sediment. About once a year this must be removed by means of jackhammers. To protect the system from this material, screens have been placed between the tanks and the open hearth pumps. These screens are made from ordinary hardware wire cloth of ¼ in. mesh and serve to remove any coarse materials which will injure the pump parts.

Prior to September, 1942, some tar was used with the pitch, but the storage tanks had to be watched very carefully to see that they contained either all tar or all pitch. Due to the lower melting point of the tar, a mixture would foam and overflow the storage tanks, and the pumps to the open hearth would become vapor bound, thus causing a loss in pressure for 15 to 30 minutes, at this time a most serious situation for an open hearth.

Several years ago, the pitch was thinned by adding tar. But here again, too high a temperature caused the mixture to foam and vaporize in the line, resulting in gas pockets.

On the other hand, in one instance, it was necessary to remove the pipe covering and heat about 2100 feet of return line to free it of hard pitch and tar, due to insufficient tar content and low temperatures.

The pitch is removed from either or both of the open hearth storage tanks by two 5 in. x 6 in. triplex, vertical-plunger type, motor-driven pumps, each having a capacity of 42 gallons per minute, at 130 pounds pressure. Generally the pitch can be pumped by one unit

with the other serving as a spare. Due to the presence of fine coke in the pitch each pump must be reconditioned about every four months.

It is not practical to have a single pitch line to the open hearth. Whenever a single line is shut off for a short period, the pitch will freeze and the line will have to be heated before it can be used again. To overcome this condition we have a "loop" system of pitch lines throughout the open hearth. That is, the pitch is pumped from the storage tanks through the entire open hearth in a 4 in. supply line. The excess pitch is returned to the storage tanks by a 3 in. return line.

Each open hearth furnace takes its pitch from one of these lines. Between the supply and the return lines a 1 in. steam line has been installed and all three lines have been wrapped with a heavy horse hair felt and tar paper (Figure 3). A pressure regulator is installed in the return line just ahead of the storage tanks. It is set to open at 120 pounds pressure, and thus approximately this pressure is maintained at all the furnaces. It is estimated that 20 to 30 per cent excess pitch is pumped around the "loop" system.

OPEN HEARTH CONTROLS

Although every precaution has been taken, it is only natural that the pitch reaching the individual open hearth furnaces is cooler than it was at the pumps. Therefore, heating tanks of 50 gallon capacity have been installed on each furnace. The pitch comes from the main supply line into the heating tank, then to the control panel and into the burners. The original tanks contained brass heating coils, but because of rapid corrosion of the brass it was necessary to change to steel coils. These steel coils have to be renewed every three to five years. The steam valves on the tanks are controlled by the furnace operator to maintain a pitch temperature of 280 to 300 F.

All meters, controls, valves, and regulators for the furnaces are mounted on panel boards, one in front of each furnace, as shown in Figure 4.

From the small heating tank the pitch passes through a hand operated valve which controls the rate of flow. Here the temperature of the pitch is measured with a well-type mercury thermometer. The liquid pitch then passes through two area-type meter bodies in series and thence to the burners. The first meter indicates and records on a chart the amount of pitch being used, while the second sends an electrical impulse to the fuel-air ratio control regulator. Both meter bodies are similar and both have steam jackets to prevent freezing of pitch in the meters. Each should be equipped with a by-pass so that a meter failure will not necessitate a shut-down of the furnace. The bronze plunger originally used in the meter bodies proved unsuccessful because of corrosion. Later the manufacturer furnished stainless steel plungers which have been found satisfactory. The meters are dismantled, cleaned, and recalibrated at the end of each furnace campaign. This eliminates most of the difficulties when the furnace is operating. However, it is necessary to inspect them once a week and drain the sediment from the base of the meter bodies.

The "combustion-control" pitch meter sends an electrical impulse to a regulator which in turn transmits an impulse by compressed air to a master loader regulator. Coke-oven gas, when available, is burnt in the open hearth and is measured by an orifice meter. The differential across the orifice is transmitted to a regulator which transmits an air impulse to the master loader. The master loader regulator controls the amount of air going into the furnaces. Thus, with the use of a gas orifice, a pitch meter and three regulators the air-fuel ratio always remains the same.

With these regulators, the furnace operators may use pitch and coke oven gas in almost any proportion and still have the right amount of air. The regulators are set to maintain proper analysis of flue gas in the downtakes.

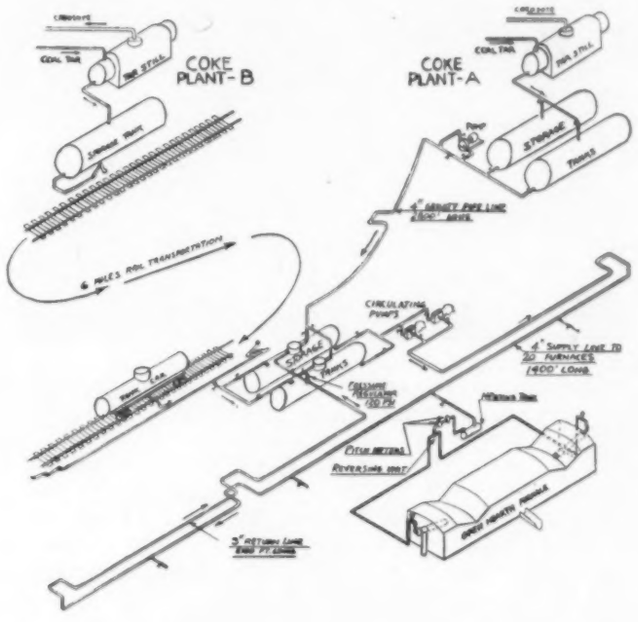


Figure 2 — Diagram showing general arrangement of pitch distribution system.

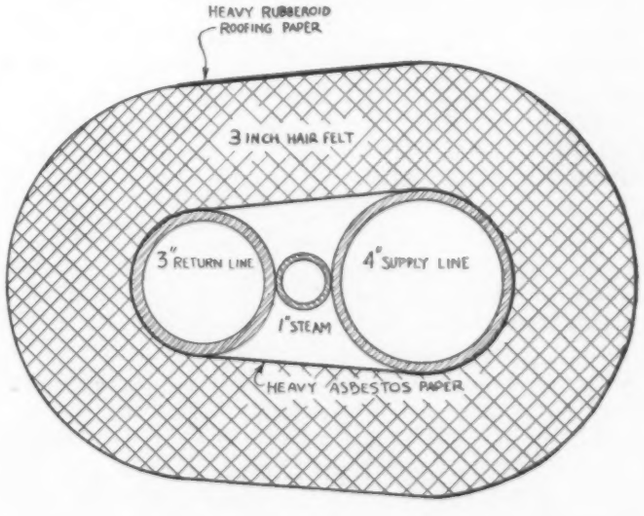


Figure 3 — Sketch showing method of running pitch lines.

The furnace may be switched from fuel oil to pitch without any change in combustion controls.

The actual flow of gas and pitch is regulated by the furnace operator according to the heat requirement of the furnace. A 6 in. gate valve serves to regulate the gas flow.

The pitch control valve has an iron body with stainless steel triports and seats. These parts are usually renewed at the end of each furnace campaign.

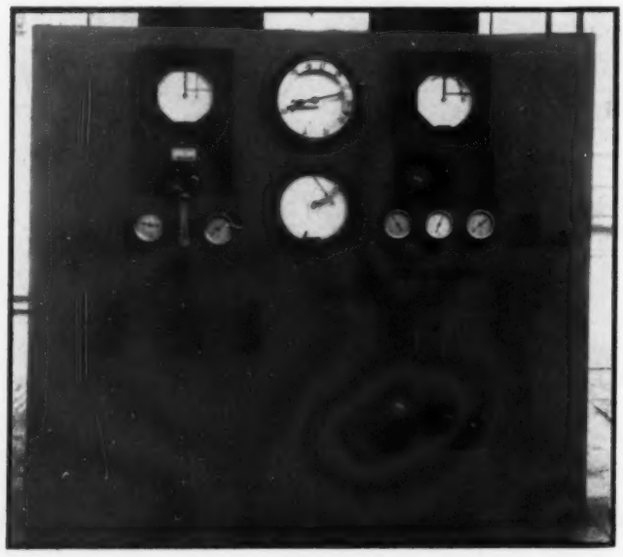


Figure 4 — Panel board for open hearth furnace equipped for burning pitch and oil.

In addition to the controls for pitch as described previously, controls are also provided for coke oven gas, furnace draft, and flows. For example, the coke oven gas is regulated to a constant pressure. The gas flow is indicated and recorded on a chart. A pyrometer is sighted against the roof of the furnace and the temperature is recorded on the panel board instrument. Other temperatures are recorded on a strip chart for various locations in the checkers and waste heat boilers. Each furnace is equipped with a thermometer and pressure gauges to indicate the pitch temperature and pressures. The steam pressure available for atomization is also shown. Each panel board is equipped with valves and levers with which the furnace operator controls furnace reversal, and gas, steam, pitch or oil flow.

We use combination coke oven gas and liquid-fuel burners. These burners are equipped with swinging joints for proper adjustment at any period during a campaign. A cross section of the burner is shown in Figure 5.

The water for cooling enters the outer jacket and is carried to the nozzle end of the burner by a small pipe inside the jacket. The water flows back along the jacket to the outlet pipe. In this manner the coldest water is impinged on the hottest portion of the burner and a positive circulation of water is maintained.

The coke oven gas is introduced directly into the burner by a 6 in. pipe.

The pitch is atomized in a mixer assembly consisting of four parts: a pipe tee, a barrel, a mixing tube and a nozzle (Figure 6). The burner assembly is attached to the burner horizontally with steam being introduced through the top of the tee, the liquid fuel through one end of the tee and the mixture into the burner from the other end. The atomized fuel is carried almost to the end of the burner by a small pipe inside the coke oven gas stream. This type of atomizer is now used on all furnaces and is giving excellent results both for pitch and oil. Although these atomizers will burn both pitch and oil, a barrel with smaller holes is used for oil. The nozzle at the end of the burner swells or grows from the heat and it is necessary to remove and ream out the end daily. This assures a good smooth end nozzle at all times.

To prevent pitch from leaking into idle burners, an iron shut-off valve is installed ahead of each atomizer, as shown in the sketch. This valve is opened or closed by compressed air controlled from the panel board. Burner maintenance and accumulations of carbon at the burner end have been considerably reduced by the installation of this valve.

The steam pressure at the atomizer is generally maintained at 90 to 100 pounds per square inch. The amount of steam used to atomize the pitch varies somewhat, according to the flow of the pitch. Studies were made of the steam flow to two different but similar furnaces for one month. One furnace was fired with pitch, the other with oil. Shunt steam meters were used to measure the steam and area-type meters for the liquid fuel. Averages for the entire month indicated that one gallon of oil required 3.0 pounds of steam and one gallon of pitch 3.9 pounds of steam for atomization.

As the supply of pitch from the coke plants varies it is necessary sometimes to switch from one liquid fuel to another. Although the same meters, regulators, burners and atomizers are used on oil and pitch certain precautions must be observed or trouble will occur. Generally about 10 minutes is required to switch fuels. The most logical time is after the heat has been tapped and the fuel is turned off. Whenever there is not sufficient time to wait until tapping, the fuels may be switched in the middle of the heat. A short delay will usually follow.

In case of changing from oil to pitch all lines must be thoroughly steamed out and warmed. If this job is not performed properly the 150 F oil will cause the 280 F pitch to harden in the colder sections of the line. In changing from pitch to oil all the pitch must be removed from the line or the colder oil will cause it to freeze.

The more difficult of the two operations is the change from pitch to oil. It appears that the lines are sometimes over-steamed and the pitch is reduced to coke. This tends to collect around the meter pistons, causing the meter to stop or to give incorrect readings. To correct the situation the meter must be dismantled and cleaned.

FURNACE REVERSALS

The following procedure is followed in reversing a furnace:

1. Liquid fuel is shut off.
2. The air operated valves are reversed. These are the valves located at the burner mixer.
3. Coke oven gas valve is closed.
4. Furnace flue valves are reversed by an electric switch.

5. Coke oven gas valve is opened until the desired flow is secured.
6. The liquid fuel is turned on.

Ordinarily the furnace is reversed every 10 to 12 minutes. If the reversal period exceeds 20 minutes the pitch to the idle burner is in danger of freezing.

Considerable care is necessary in steaming out the fuel lines when the furnace is off. The lines from the main to the burners must be thoroughly freed, otherwise the pitch will freeze. This "steam-out" includes the heating tank and meters. Due to the care taken by the operators at this stage no difficulties with blocked lines have been experienced for several years.

COMBUSTION OF PITCH

The flame produced using pitch is heavy and impinges on the bath very well. The percentage of free carbon produces high luminosity. Measurements made with an optical pyrometer of the "disappearing dot" type indicate that the pitch flames have a higher temperature than the oil flames. Our instrument reads to 3400 F and we use this to measure the temperature on all furnaces. On the pitch furnaces the flame temperatures frequently go over 3400 F at the first door.

A. J. Fisher, fuel engineer at Bethlehem Steel Company's Sparrows Point plant, visited our open hearth about a year ago. With his instrument, as described in May, 1943, Iron and Steel Engineer, he measured the flame temperatures. This instrument also indicated that the flame temperature of pitch is higher than that of oil. All measurements were made just before tapping, when the furnace is the clearest.

H. C. Siebert, combustion engineer, Bethlehem Steel Company, calculated theoretical flame temperatures of two different grades of oil and two different pitches. With flame temperatures at 90 per cent of theoretical and with no excess air he calculated the temperatures at 3750 to 3780 F for fuel oil and 3760 F for pitch. With 10 per cent excess air the calculated values were from 3560 to 3600 F for oil and 3560 to 3600 F for pitch. With 25 per cent excess air the flame temperatures were 3360 to 3400 F for oil and 3400 to 3420 F for pitch and with 50 per cent they were from 3090 to 3140 F for oil and 3140 to 3160 F for pitch. From these figures it is seen that theoretically there is not much difference between the flame temperature of oil and pitch.

In general there seems to be a difference of opinion as to which fuel, pitch or oil, gives the higher temperature. Recent experiments by Dr. D. W. Murphy of the Bethlehem Research Department indicate that the flame temperature of pitch is no higher than that of oil, but that the radiation from the pitch flame is greater than from the oil flame. As already stated, first helpers as a rule prefer the pitch.

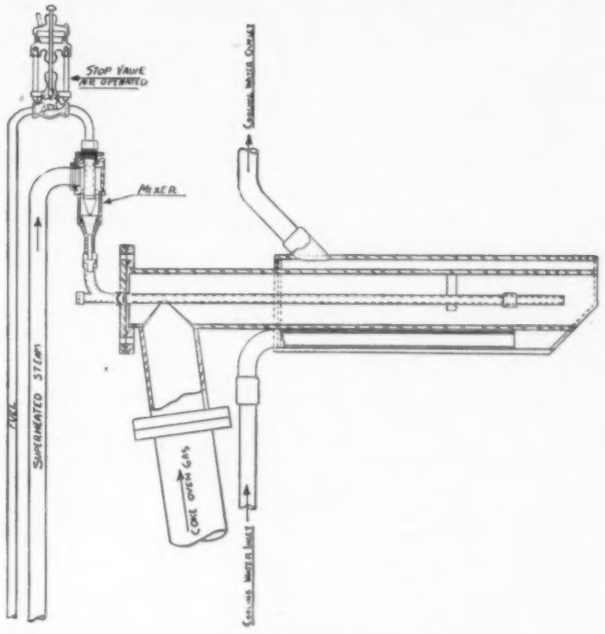
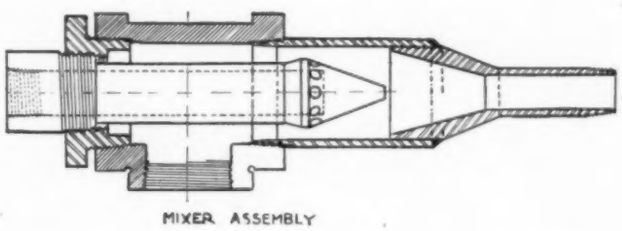


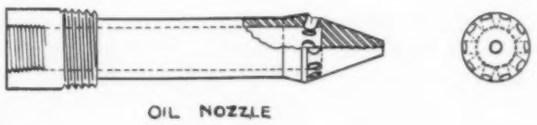
Figure 5 — Cross section of combination burner for gaseous and liquid fuels.

To determine what effect oil and pitch have on the tonnage and the heat required per ton a study was made of two similar open hearth furnaces. This study covered five campaigns on each furnace, extending from September 1941 to January 1943. One furnace burned only pitch, the other oil only. The average of the five campaigns on pitch showed that 10.68 net tons of steel were produced per hour, with 4,420,000 Btu per ton. The furnace on oil for five campaigns made 10.07 net tons of steel per hour, using 4,160,000 Btu per ton. Thus the furnace using pitch made 6.0 per cent more steel but required 6.3 per cent more heat.

Further studies of the problem revealed that there were several other furnaces which would operate a part of a month on pitch and part on oil. On comparing the part of the month in which oil was used against the part when pitch was used, it was found that pitch would generally produce greater tonnage per hour than oil but not so much as the 6.0 per cent as previously found.

Figure 6 — Sketches showing details of mixer assembly and oil nozzle.





The heat required on the pitch portion of the month was greater, although not so high as the 6.3 per cent shown previously.

In the first method of approach to the problem of fuel vs. tonnage two identical furnaces were used at the same time. In the second method the same furnace was used, but at different times. Thus, in our opinion, the increase in tonnage and heat in-put when using pitch would fall somewhere in between the results of the two methods. That is, with a change from oil to pitch in an open hearth a slight increase (perhaps about 3 to 5 per cent) in the steel tonnage should be expected with a corresponding increase (3 to 5 per cent) in the heat in-put.

It is generally conceded in most plants where both oil and pitch are used, that the tonnage rate on pitch is higher — one plant reports as much as 10 per cent.

In making a study of the deposits in the open hearth checkers, samples were taken on four different furnaces in the slag pockets, first, second, and third pass checkers, and sewers. These samples were taken at the end of a campaign. On two of the furnaces 100 per cent oil was burned during the campaign. The two other furnaces burned 97 per cent pitch and 75 per cent pitch, the remainder being oil. The amount of coke gas burned was not considered as it would tend to be equal on all furnaces.

The deposits were analyzed for ferrous and ferric oxide, silica, manganese oxide, alumina, lime, magnesia, sodium oxide, sulphuric anhydride, phosphoric anhydride, zinc oxide and chromium oxide. The ferric oxide, of course, makes up the bulk of the deposits in all checkers. It was noticed that the ferric oxide increased gradually from the slag pocket to the sewers, while silica decreased.

A comparison was made of the analysis of the deposits of the furnaces using oil and of those using pitch. As a general tendency, the pitch furnaces seemed to give deposits higher in ferric oxide and lower in silica than the oil furnaces. This seemed to be true in all parts of the checkers. Data were not collected on the amount of the deposit with each fuel. However, our bricklayer foremen believe that the pitch furnaces show the greater amounts of deposits. The iron oxide and silica content of slags and deposits in the second pass of the open hearth furnace runs as follows:

Fuel used	Furnace No.	Per cent	
		Fe_2O_3	SiO_2
Oil	62	73.1	5.2
Pitch	56	88.8	1.2

The appearance of the material removed from the pitch checkers is black and looks very much like coke. Until it is analyzed one would think it contained a high per cent of carbon. The analysis, however, shows no carbon present. Whether there is any carbon carry-over into the checkers is not known. It is possible that when the deposit first accumulates it may contain carbon which is burned out later.

Our refractory engineers have not observed any difference in the furnace life or brickwork on oil or pitch furnaces. A study of rebuilding cost, roof life, refractory repairs, checker replacements, show that except for the slightly greater amount of deposit in pitch-furnace checkers, the refractory cost is approximately the same for furnaces using either type of fuel.

OTHER FUEL APPLICATIONS OF PITCH

While this paper deals with pitch used as open hearth fuel it should also be pointed out that pitch can be used for purposes other than steel melting, although it is not recommended. There are however, several steel plants reported using pitch successfully on reheating furnaces. This, it seems, must be a rather difficult job due to the disadvantages in turning down the flow. It is readily seen that there would be considerable difference in controlling pitch to a small furnace when only 5 to 10 gallons per hour is used, compared with using it at a rate of 300 to 400 gallons per hour. With low flows the first trouble encountered is the possibility of the lines freezing when the velocity is reduced. The first lesson we learned in handling pitch was to keep it hot and keep it moving. Then there is the trouble with a small burner. When the flow-control valve is throttled to only 10 gallons per hour a very small piece of free carbon will quickly plug up the burner. For these reasons it is thought that pitch can best be used where it is handled in large quantities.

SUMMARY

We have attempted to show in this paper how pitch is used as a fuel in one open hearth plant.

The most important item to consider in the handling of pitch is to keep it at the proper temperature: Too high a temperature will cause it to foam; too low a temperature will cause it to solidify in the lines. Steam lines should be installed parallel to pitch lines and both lines should be wrapped together with insulation.

Sufficient storage tanks should be available at both the open hearth and coke plant to give the transportation system some flexibility. Storage tanks, particularly at the open hearth, should have steam heating coils to maintain the necessary temperature in the pitch system.

Single pitch lines should not be installed; piping should consist of a supply and return line. Our experience indicates that it pays to keep the pitch in motion at all times.

All meter, valve, and regulator parts in direct contact with pitch should be stainless steel, and should be inspected at the end of each furnace campaign.

Our experience indicates that 1,200,000 gallons of bunker "C" oil is saved monthly by using pitch and a corresponding saving in transporting this quantity of liquid fuel is made, since the pitch is not handled by the main railroads.

The burning of pitch is, in general, easy after the proper system and controls have been installed. The flame temperature may be a little higher than that of oil and the net tonnage per hour seems to be slightly higher with the use of pitch, but the heat equivalent per ton is also higher. The deposits in the checkers appear to be of a different analysis from that produced by oil.

The amount of the deposit seems to be greater on a pitch-fired furnace.

As pointed out, the furnace operators seem to prefer pitch. We feel, therefore, that pitch when properly handled makes an excellent open hearth furnace fuel.

DISCUSSION

PRESENTED BY

J. G. HIMES, Power and Fuel Engineer, Ohio Works, Carnegie-Illinois Steel Corporation, Youngstown, Ohio

F. S. BLOOM, Bloom Engineering Company, Pittsburgh, Pennsylvania

J. F. WILBUR, Superintendent Steam and Combustion Department, Bethlehem Steel Company, Johnstown, Pennsylvania

H. R. COULSON, Open Hearth Superintendent, Bethlehem Steel Company, Johnstown, Pennsylvania

R. S. SHOEMAKER, Lubrication Engineer, American Rolling Mill Company, Middletown, Ohio

P. C. McKENZIE, Herr-Harris Company, Pittsburgh, Pennsylvania

E. C. McDONALD, Combustion Engineer, Republic Steel Corporation, Cleveland, Ohio

P. F. KINYOUN, Combustion Engineer, Bethlehem Steel Company, Lackawanna, New York

J. G. COUTANT, Fuel Engineer, New York, New York

C. J. WYROUGH, Superintendent Steam Efficiency and Combustion Department, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania

J. B. CRANE, Combustion Engineering Company, Pittsburgh, Pennsylvania

A. J. FISHER, Fuel Engineer, Bethlehem Steel Company, Sparrows Point, Maryland

J. G. HINES: Mr. Wilbur's paper can be considered very timely in view of the increasing demand for tar distillates. Disposing of the pitch residue as fuel, in spite of the inherent difficulties involved, is a definite contribution to the steel industry.

The point Mr. Wilbur makes of the precautions that must be taken when switching from tar or pitch to fuel-oil is one that has concerned us for some time. It has been generally known for a long time that fuel-oil and by-product tar or pitch can not be mixed without plugging of meters, burners, and so forth. This has resulted in elaborate procedures for purging the entire fuel system between switch-overs. If the supply of tar is sporadic, and frequent switch-overs must therefore be made, there results a loss of considerable man-hours and furnace-operating-hours. It was with this picture in mind that an investigation of tar and of fuel-oil mixtures was started by us.

The tar used as fuel at our plant is of moderately low viscosity as shown by the fact that it is easily atomized if pre-heated to 170 F. This is incidently the temperature to which the fuel-oil is generally pre-heated. The fuel-oil is the "Bunker C" No. 5 and 6 fuel-oils commonly used by most plants.

As a start, varying proportions of tar and fuel-oil were mixed at 170 F. The following facts were found:

1. Mixtures containing more than 60 per cent tar by weight were homogeneous having a viscosity similar to that of tar. This explains why it is easier to switch from oil to tar than from tar to oil.
2. Mixtures containing less than 60 per cent tar by weight resulted in a precipitate being formed which conglomerated in large dense masses.

To the best of our knowledge, the tar alone is the source of the precipitate. This is substantiated by the fact that chemical tests show it to be aromatic in nature. In addition, in no instance, was more precipitate by weight formed than there was tar in the original mixture.

The resulting theory is that since the tar is aromatic in nature some of its high molecular weight molecules are insoluble in the aliphatic fuel-oil.

On the basis of these facts, it was hoped that some solvent or dispersing agent might be found which then added to the tar would keep the insoluble tar molecules finely dispersed when the oil and tar were mixed.

Originally only coke-plant by-products were used. Benzol, toluol, and xylol were tried since they are all soluble in the fuel-oil and tar. None of these was found to be satisfactory dispersing agents.

Several commercial solvent companies were then asked to furnish samples of solvent which they thought might serve as suitable dispersing agents and to date, we have received several. So far we have only been able to run tests on one of the solvents received.

This solvent was heated to 170 F, then added to the tar at 170 F and agitated until a smooth mixture resulted. The tar conditioned thus deposited no precipitate when mixed with fuel-oil in any proportion regardless of temperature of mixing. However, this solvent was not considered satisfactory since the amount of solvent required was as high as 34 per cent by weight of the tar, thus making the cost prohibitive. Yet this proved that some other solvent might be found which could be added in such minute amount (say .1 per cent) that it might be commercialy feasible.

In this regard we have only begun our investigation. We have tried only one solvent and expect to continue our investigation in hopes that we may find one that might solve the problem economically. We would be interested in knowing if anyone else has had occasion to conduct an investigation of this type and what success they may have had.

F. S. BLOOM: Apparently pitch specifications vary. Pitch tar as you have it at Bethlehem will be entirely different from a tar you have at some other plant.

There are one or two questions I would like to ask, however:

1. Would you recommend a pitch system for an open hearth plant if you didn't have along with it an oil system entirely separate?
2. Is it possible to maintain your pitch so it will flow if sufficient steam tracer lines are provided?
3. As I understand the system on your open hearth, you have difficulty with the off burner if you stay too long on one end without reversing. Do you mean

that this dead end line will plug if you do not reverse within a reasonable interval of twenty minutes, or if you have fuel off your furnace for more than twenty minutes, you must purge the pitch line to the furnace?

J. F. WILBUR: The first question: The pitch supply is variable, because there are some items which cause trouble in the operation of the tar stills and which interfere with the continuous production of pitch. The supply and manufacture are variable, and so far are not thoroughly dependable. So you have to have a ready oil supply to be able to change over quickly.

The only alternative would be to have such a storage capacity for pitch that a supply of pitch could be maintained even though the tar still might be down for as much as twenty-four hours for cleaning and repairs.

F. S. BLOOM: Well, do you think you are playing with too much dynamite to put all your eggs in one basket?

J. F. WILBUR: Under the present set up I know we would be. We wouldn't try to get along with just a pitch system. We have 21 open hearth furnaces, and I will refer the question to Mr. Coulson, our open hearth superintendent who is present. Mr. Coulson, how many furnaces do we have piped both for pitch and for oil?

H. R. COULSON: We run anywhere from two to ten furnaces, depending on the supply.

J. F. WILBUR: In answer to Mr. Bloom's third question, about having two separate systems, we find it necessary to have two complete separate systems, one for pitch and one for oil, and change right at the furnace.

F. S. BLOOM: In other words, you wouldn't recommend a whole new plant being put on pitch without some standby, such as oil?

J. F. WILBUR: Put in duplicate systems to every furnace, because inevitably something will happen to the pitch supply.

F. S. BLOOM: If you put in a big enough steam tracer line, could you keep your pitch hot so it wouldn't freeze up? Suppose it was down for an hour, would your steam tracer lines keep it hot, or could you thaw out your tar line with a big enough steam tracer system?

J. F. WILBUR: We'd like to keep our lines empty when the pitch is not moving. If, for any reason, we shut off the line, we immediately try to get it purged out, get it steamed out.

It all depends on how much heat you can get, the temperature of the steam in the warming line, and how well the line is wrapped and protected. Those things count.

F. S. BLOOM: In other words, you can't thaw out a frozen line with steam just on the outside; is that what you mean?

J. F. WILBUR: That is correct. We weren't able to with our system. There were 200 feet of pipe, which we refer to as a gravity system, because the coke plant is situated 75 ft higher than the open hearth. We had to go along about every ten or twelve feet, that is, a little less than the length of a pipe, and cut holes in the four-inch pitch line. As a steam lance is forced into the pipe, the pitch melts and flows out. In a minute or two the lance is advanced until finally the whole pipe has been worked out.

F. S. BLOOM: You mentioned that, in keeping your furnace on one end more than fifteen or twenty minutes, the tar burner on the opposite end freezes up. Isn't there any possibility with pitch to keep this pitch line hot with steam tracer lines?

J. F. WILBUR: Yes, that is possible. When we say "purge the burner," we purge the burner only, not the line from the reversing valve at the panel board to the furnace. We shut off at the burner and purge from the burner through the atomizer.

R. S. SHOEMAKER: How much of a coke plant is back of this installation? How many coke ovens?

J. F. WILBUR: There are two coke plants, 154 Becker type ovens in one plant, and 208 ovens of Semet Solvay and Cambria type in the other. We make about 4500 tons of coke per day in the two plants.

R. S. SHOEMAKER: Then you are operating only seven ovens, because you have the coke plant down?

J. F. WILBUR: No, the Barrett direct tar still was put on only seven ovens which at that time was all the production we wanted for creosote oil. Later, as you know, in fact early in 1943, a directive was issued by the Fuel Administration, that no tar should be burned as fuel; all must be distilled. So when our development of tar stills continued, instead of putting more still capacity at the one coke plant, we increased the capacity at the other plant and shipped the tar from one coke plant to the stills at the other. One plant distills approximately seventy per cent of our total tar production, the other about thirty per cent.

P. C. MCKENZIE: Mr. Wilbur, you mentioned the rapid corrosion on brass parts compared with steel in the tar heating system. Do you know what causes this?

J. F. WILBUR: Tar ordinarily contains acids. One of the purposes for distilling the tar is to remove the acid oils. And the pitch contains a certain amount of acid which undoubtedly is partly responsible for the corrosion. Furthermore, the fine particles of carbon that are carried with the pitch are very abrasive, which probably also has something to do with it.

E. C. MCDONALD: I have always been under the impression that when a furnace is operated on pitch, the furnace life is shorter, due to the plugging of the checkers. You covered that subject in your paper, but didn't seem to be concerned much about the effect of increased deposits on the checkers. I have always been under the impression that furnace life was considerably less from increased deposits in the checkers when burning pitch. What is your opinion on that?

J. F. WILBUR: Well, we have considerable trouble with plugging checkers on all furnaces, and I think most everybody else has the same experience. It is a little hard to differentiate between the two. We do think there is more carry-over — I think I made a statement to that effect — and a greater deposit in the pitch checkers than in oil.

E. C. MCDONALD: Not enough to say there is a shorter life though in pitch furnaces?

J. F. WILBUR: Our furnace life in my opinion depends mostly on the roof, and I will pass the question on to Mr. Coulson. Is not our furnace life determined by the roof life rather than by the conditions of plugged checkers?

H. R. COULSON: Well it's about fifty-fifty. When we take a furnace off on account of the roof, the sewers are filled up nearly to the arch. We blow our checkers

about every two weeks, and by so doing a proper draft is maintained. There is quite an accumulation of soot in the sewers, generally from three to four feet.

I might say that I don't quite agree with Mr. Wilbur's statement that there is a slight increase in carry-over from pitch to oil. I'd say that the ratio is more nearly two to one. The pitch gives a much greater carry-over than oil, and for that reason we clean our pitch furnaces more often.

P. F. KINYOUN: Our experience with pitch at Lackawanna started about March 1942. There has been difficulty with the pitch plant not functioning a hundred per cent of the time. We have been switching back and forth from pitch to oil a great many times during each month, with approximately ten minutes between each switch-over, and our percentage over a period of about sixteen months has probably been on the order of sixty to seventy per cent pitch and thirty to forty per cent oil. This has not always been due to the fact that pitch would not be available, but was sometimes caused by conditions in the pitch plant.

Our first experience with pitch indicated a very marked reduction in fuel consumption per ton, which is contrary to Mr. Wilbur's experience. Our production rate also increased as much as ten per cent.

Based on present experience I would agree on about 5 to 10 per cent increase in production, while we hold our own in Btu per ton with perhaps as much as 5 per cent in favor of the pitch.

In connection with Mr. McDonald's statement about the plugging of the checkers, we found it necessary — at least we have done it — to increase the size of the opening in our checkers on our 200-ton furnaces. The original checker opening was 7½ in. in the first pass, the hot pass, and 5½ x 5½ in the second, or cold pass. During the last six or seven months we have gradually changed all over to 9 x 9 in. in the first pass and to 7½ x 7½ in. in the second. So I agree with Mr. Coulson that the accumulation compared with fuel oil is probably in the order of two to one.

We have a different situation at Lackawanna than at Johnstown in that we carry the pitch temperature between four and five hundred degrees, which is the incidental temperature we get from the pitch plant. We don't recirculate the pitch at the open hearth. We have pumps at the pitch plant which pump and circulate around the open hearth department and back to the pitch plant, rather than back to the local tanks at the open hearth department itself.

At first thought that we would get the pitch delivered at about 250 degrees, and that we would raise it to 300 degrees similar to Johnstown. However, as our stills are operated, I can't tell you exactly why, it is delivered at about 450 degrees, except that we don't allow it to stand long at the pitch plant.

Now that may perhaps have some bearing on our better experience on production and fuel consumption. As far as I know, the only fundamental difference between the operation at Lackawanna and Johnstown is in the pitch temperature. But the open hearth men like it, and I think the five per cent production increase is probably a conservative estimate.

In other words, when we went on pitch, we speeded right up. However, some other variables may have been introduced with the more inexperienced labor and the longer charging delays. These, I feel in my own mind, may have offset the full benefits of pitch, although I can not back up that claim. I do believe, however, that on our furnaces at least with all other conditions being equal, you may expect an increase of somewhat over five per cent, or maybe as much as seven or eight per cent, with lower Btu per ton. That has been our experience at Lackawanna.

J. G. COUTANT: I think perhaps some experiments which I have made for the Cuban government might be of interest. In Cuba they have a great deal of asphalt. The asphalt is solid pitch, or hard pitch. With the colloidal mill we take the solid pitch and reduce it to a fineness about thirty mesh. Then it is mixed with the oil and forced through a colloidal mill.

As I made the experiments, I put it in the water cooled colloidal mill at seventy-five degrees and it came out of the mill at 175 degrees. It is a perfect colloid in which solids stay in suspension; and has a viscosity equal to Bunker "C." It is intended to be pumped through ordinary oil-burning systems as would apply to Bunker "C" oil.

In England they are burning more pitch for heating furnaces. They use a creosote instead of oil. This makes a home fluid fuel for which burners have been designed to supply as low as one-half gallon per hour.

C. J. WYROUGH: On the matter of comparative furnace life when using oil or pitch, we have found that oil fired furnaces have a life twenty-five to thirty per cent longer than similar furnaces using pitch.

Mr. Wilbur spoke about experiencing considerable trouble with piston and cylinder wear on pumps handling the pitch. We found on our system that it was necessary to install plate strainers, with about .020 in. clearance, on the suction side of the pumps, and with those strainers we have very little trouble with our pumps.

J. B. CRANE: I was very much interested in Mr. Wilbur's paper because I have been in the export business since 1937. I have just come back from a visit to South America. The scarcity of fuel down there is even worse than it is here. Argentine usually imports about 3,500,000 tons of coal a year, and they are now getting about 70,000 tons a year. They burned 8,000,000 tons of corn in the last two years, and on the large furnaces they put a flour mill in front of each boiler and they put the corn, which has 7000 Btu directly into the furnace. On smaller boilers they built a Dutch oven out in front of the furnace and feed the corn on the cob and burn it in the Dutch ovens. They burned up all the corn, and now they have gone to linseed.

When I was down there the boilers at a station in Buenos Aires were burning linseed. But in most of the places, they blow that directly into the furnace and enough oil is in it so that it explodes and they don't have to do anything else with it.

The question of burning pitch is quite important. There are several million tons of petroleum pitch in the oil fields at Aruba that can be purchased very cheaply by some American companies, but the question of burning it has been the trouble. At Skelly Oil, in Eldorado, Kansas, several years ago, we put in an installation with an impact mill, and we had to put the mill very close to the furnace. They had to use the type

(*Please turn to page 77*)

Supervisory Control

FOR INDUSTRIAL PLANT POWER

. . . . the soundness of supervisory control has been proven over 20 years in the central station industry . . . . such control is well adapted to large industrial plants . . . .

by W. A. Derr, SWITCHGEAR ENGINEER

Westinghouse Electric & Manufacturing Company

EAST PITTSBURGH, PENNSYLVANIA

▲ SUPERVISORY control, which is remote control over a limited number of conductors, was developed twenty years ago for the control of railway substations, switching stations, hydro-electric plants and the like. On installations of this kind, supervisory control was the only practical method of eliminating man-power from remote stations and obtaining unified control, due to the relatively long distances involved. The fact that supervisory control equipment can be operated over a single pair of telephone type wires between the dispatching office and the remotely controlled stations meant that it was the only economical method of remote control in these instances. Recently supervisory control has entered a new field. This new field is the control of the electrical power system of large industrial plants.

In large industrial plants, such as steel mills, the necessity of having a power supply to various units of the plant necessitates the use of switching means at these various locations. On past installations, each of the switching locations has been considered a separate entity, with the electrical switching means at each location, such as circuit breakers and disconnect switches, being locally controlled only from a switchboard at that particular location. Thus, the overall electrical distribution system of the plant was under the control of the operators at the various switching locations with the actions of the various operators being co-ordinated by a telephone system.

Quite recently it was decided to gain the advantage of unified centralized control at two steel plants. Centralized control in an industrial plant means a single control location for the remote control of electrical apparatus located in various buildings throughout the plant. By means of centralized control, a single operator or dispatcher has control of the electrical distribution system of the entire plant, thus making possible more flexible and efficient operation and also reducing the manpower requirements.

The supervisory control equipment being applied at the two steel mills, is of the "all-relay" visicode type, using standard telephone type equipment of the most reliable kind. This two wire type of supervisory control equipment is the culmination of many years of experience and development with this type of equipment.

The supervisory control equipment is operated from storage batteries, thus assuring control, even in the event of loss of a-c power.

The supervisory equipment operates by means of "coded" impulses, thus providing protection against the possibility of false operation of any unit controlled, due to foreign voltages on the line wires.

Supervisory control functions are performed from escutcheons which are 5 inches long and 1½ inches wide. The escutcheon is a small shield which has assembled on it all of the control keys and indicating lights associated with a given apparatus unit. An escutcheon for the control of a breaker, as well as a supervisory control relay, are shown in Figure 1.

The supervisory control equipment for each remotely controlled location consists of supervisory control relays and interposing relays. The interposing relays are operated from contacts of the supervisory control relays. The contacts of the interposing relays perform the duties performed by local control switches.

Presented before A. I. S. E. Chicago District Section Meeting, January 5, 1943.

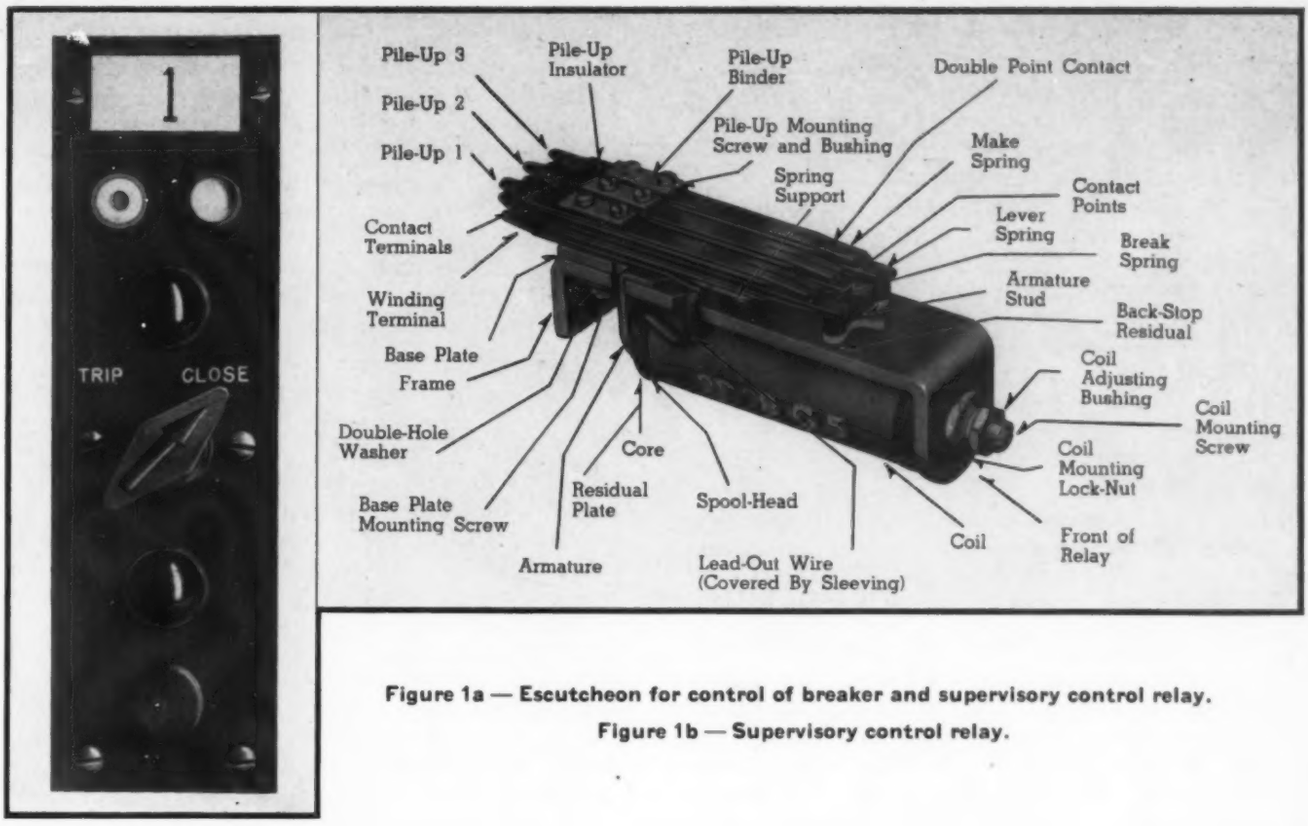


Figure 1a — Escutcheon for control of breaker and supervisory control relay.

Figure 1b — Supervisory control relay.

DETAILS OF OPERATION

The selecting system of the visicode supervisory control consists of straight counting codes. When the selection of a unit is initiated by the dispatcher, the proper code is sent to the remote station. The selected relay must then return this same code to the dispatching office to light the selection lamp on the associated escutcheon. Thus, a selection must be properly checked before it is possible to proceed with an operation. If the returned code does not agree with the selection code, it is not possible to perform an operation.

After selection, the dispatcher turns the twist type control key to the desired "trip" or "close" position and then operates the master control push button. The closing or tripping code is then transmitted, causing the selected unit to operate. An auxiliary switch on the device controlled causes its new position to be reported to the dispatcher.

If a breaker trips automatically, the auxiliary switch causes the selection code to be transmitted to the dispatching office. In this case, the check code is returned from the dispatching office. If the proper check code is received at the controlled station, the supervision code is transmitted to change the lamp indication from red to green. Simultaneously, an alarm bell is sounded at the dispatching office and the station alarm lamp is lighted. The lighting of the station alarm lamp makes it possible for the dispatcher to readily locate the station at which the operation took place. In addition, a disagreement lamp on the escutcheon assigned to the breaker is lighted — this shows which breaker operated. If desired, the dispatcher may immediately select and reclose the breaker.

To initiate the automatic check of all apparatus units in a station, the dispatcher operates a master key called the "check" key. This makes it possible to make a periodic check on the proper functioning of the equipment.

The supervisory control codes are transmitted at the rate of approximately fourteen impulses per second. The average length of time required to close or trip a breaker by means of supervisory control is less than three seconds. The fact that relays of extremely long life are used throughout provides for fast and reliable operation. The control is inherently anti-pumping and all selections are automatically checked.

SUPERVISORY VERSUS DIRECT WIRE CONTROL

Due to the relatively short distances involved between the central control point and the various units to be controlled in an industrial plant, there are two methods of obtaining this control which are both economically sound. One method is by means of supervisory control, in which only two conductors are required between the central control point and each remote switching location. The other method is by means of direct wire control in which several wires are required between the central control point and each unit (circuit breaker or disconnect switch) to be controlled. With supervisory control, only two wires are required between the central control point and each remote switching location regardless of the number of units to be controlled. With the direct wire control system, the number of wires between the central control location and the remote switching location is dependent on the number of units to be controlled at that location. The direct wire system requires a minimum of equipment whereas the super-

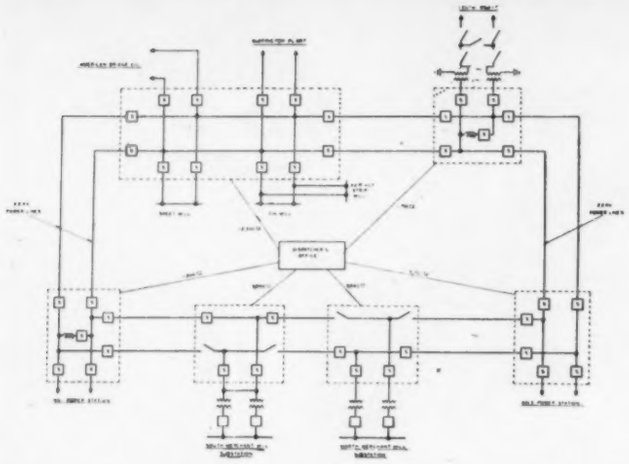


Figure 2 — Electrical distribution system of a steel mill using supervisory control.

visory control system requires a minimum of conductors. Where the distances involved in a large industrial plant are around one mile, the overall cost of the two systems is nearly the same. However, due to the considerable amount of cable copper required for a direct wire control scheme, the amount of critical war material required is greater for a direct wire control scheme than for the supervisory control system.

Supervisory control provides the following advantages over a direct wire control scheme for the control of the distribution system of a large industrial plant.

1. Operates over a single pair of wires, thus reducing possible line wire troubles to a minimum.
2. Protection of control equipment from possible contact with power lines or induced voltages from power lines made easy due to use of only two wires. Coded control used by supervisory control protects against false operations due to foreign voltages which might get on line wires.
3. Type of control equipment used with supervisory control takes up a minimum of space, thus making it possible to arrange controls in miniature bus layout.
4. Supervisory control equipment can take care of future additions to system without the use of additional conductors, and with a minimum of changes.
5. The control wires are continually supervised, thus making the operator immediately aware of loss of control.
6. A separate telephone system is not required, since communication can be incorporated in supervisory control system without the use of additional conductors.
7. Selective telemetering indications can be provided by supervisory control equipment without the use of additional conductors.

SUPERVISORY EQUIPMENT

Figure 2 shows the electrical distribution system of a steel mill for which supervisory control equipment has been built. All of the circuit breakers which will be under supervisory control are indicated by an S. The breakers in each of the six locations under supervisory control have been grouped on the drawing. As indicated on the drawing, the supervisory control equipment requires two wires between the dispatching office and each of the six remote locations. On this particular installation pilot wire protective relaying is used between the various locations, and the supervisory control equipment will operate over two wires in the control cable which also provides conductors for the pilot wire relaying and for continuous telemetering indications. The distances between the various locations on this particular installation are indicated on Figure 2.

In addition to providing control and position indication of the circuit breakers shown on Figure 2, the supervisory control equipment provides for the synchronizing of certain of the breakers, it provides an indication as to whether or not a particular remote location is on "local" or "supervisory" control, and it also provides complete telephone communication between the various locations.

Figure 3 shows the front of the dispatching office board furnished for the control of the units shown on Figure 2. It will be noted that the supervisory control escutcheons, on which are mounted the control keys and breaker indicating lamps, are arranged in a minia-

Figure 3 — Dispatching board for control of units shown in Figure 2 — front view.

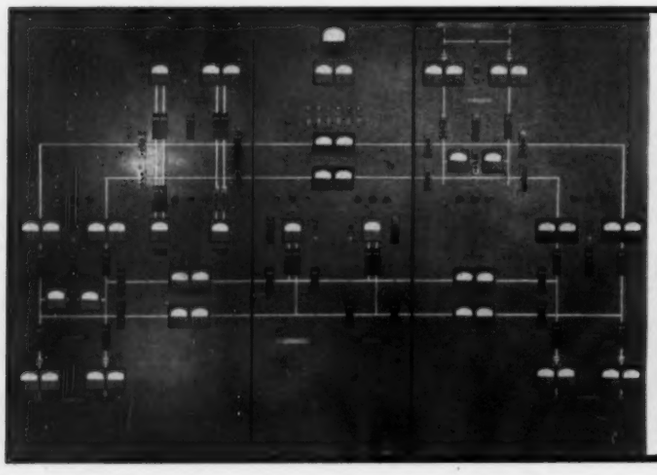
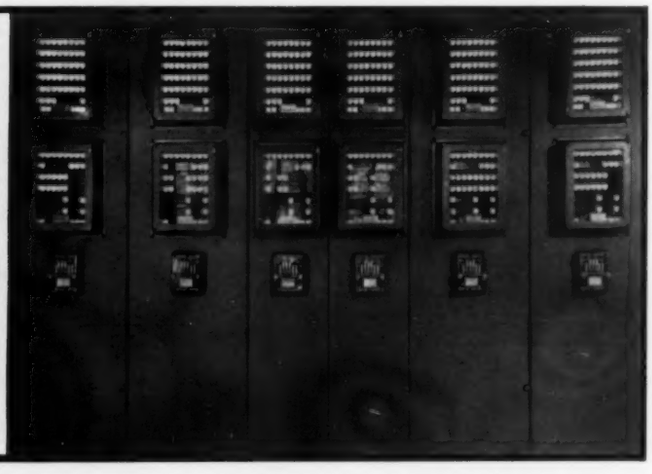


Figure 4 — Dispatching board for control of units shown in Figure 2 — rear view.



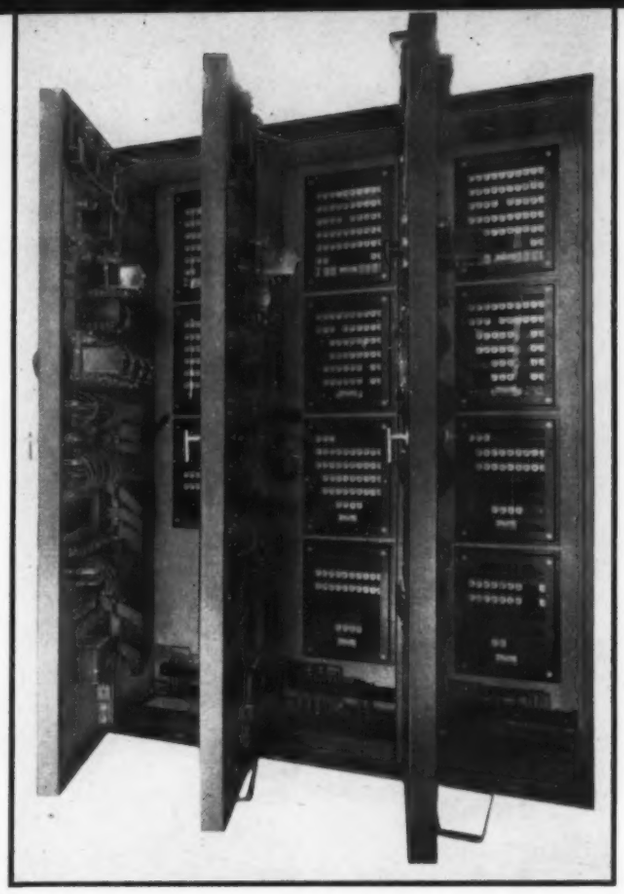


Figure 5 — Typical flush-mounted relay cases located on inside stationary panel.

ture bus arrangement depicting the actual 22 kv electric power system. It will also be noted that indicating instruments are located in the miniature bus layout. These indicating instruments provide readings of the kilowatt and reactive-kilowatt ampere flow on the various lines.

Figure 4 is the rear view of the board shown on Figure 1, showing the supervisory control relay cases mounted on swinging panels. It is to be noted that the relay cases in this figure are projection mounted. Figure 5 shows a typical arrangement of flush mounted relay cases, with the cases being located on an inside stationary panel.

Supervisory control equipment is now being built for a new steel mill which will involve the control of many more units than are indicated for the plant shown on Figure 1. At this new plant complete control and supervision will be provided for all 6900 volt a-c, 2300 volt a-c, 460 volt a-c, and 250 volt d-c breakers in the various parts of the mill. In addition to controlling all of the breakers, the supervisory control equipment will be used to start and stop some motors, fans and heaters and also to operate some permissive switches. Thus, on this installation the supervisory control operator will be concerned with the overall operation of the plant and will at all times be aware of conditions in the plant. Transfer switches will be provided on all equipment so that each particular unit can be either controlled locally or by supervisory control. The supervisory control operator will be provided with an indication of the transfer switch position. Communication will be provided between the various locations by means of the supervisory control equipment.

In this new plant there will be eleven stations controlled with a total of approximately 500 functions being performed.

Supervisory control equipment has been serving the central station industry for over 20 years. During that time the reliability and soundness of this type of control has been proven.

The electrical distribution problems of a large industrial plant are similar to those encountered in the central station industry, hence supervisory control is well suited to provide for the control of this distribution system. Centralized control provides many operating advantages and supervisory control provides a means of obtaining centralized control of electric power in large industrial plants.

The saving in manpower which results from the use of supervisory control is extremely important at this time. It is estimated that there will be an 80 per cent saving in man power on the two steel mill applications mentioned.

It is expected that this type of control will be considered for new large industrial plants.

WILBUR *Discussion*

(Continued from page 73)

of mill that does not heat up the pitch when you pulverize it. The pitch is blown directly into the furnace, and you have to cool your burner so that you don't gum up the end of your burners.

In Cuba they are now using some flour mills. The asphalt they have there grinds very readily and they are pulverizing that, and putting it under boilers in the same way. They also are burning bran in the Argentine. They can't burn it in boilers because the bran has an effect on the refractories, but they are burning it in cement mills down there, because they don't have oil.

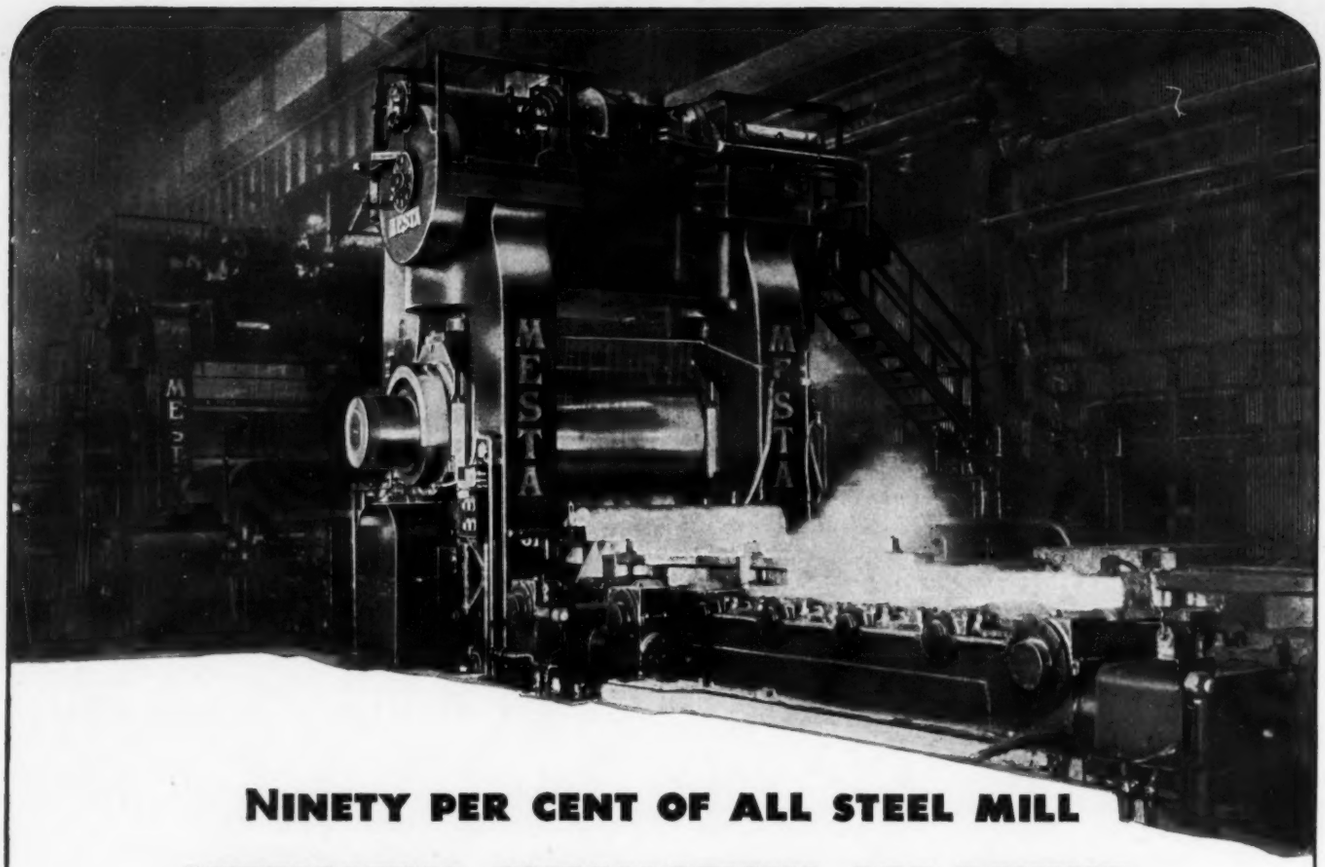
There's a lot of oil in the Argentine, but that is used on the Diesel engine plants and for running the locomotives.

I also visited Volta Redonda, where they are putting in this new Brazilian steel plant, and they were trying to get the coke ovens in service, because the only coke they were getting was from South Africa and cost them $50 a ton, laid down in Brazil.

J. F. WILBUR: In the discussion of pitch and the oil flame temperatures, opinions seem about equally divided as to which fuel gives the higher temperature. I would like to ask Mr. Fisher if he has anything new to add about that.

A. J. FISHER: No, not particularly, except that in atomizing our oil with steam — I am speaking of thoroughly mixing the steam and the oil — I did recently notice that we were able to obtain a flame of very high temperature, almost incandescent to the eye. However, the radiation from that flame, the total radiation, was less. In the study of using pitch as fuel I therefore think that the type of burner used and the relation of steam to oil in the atomizer all play a great part in getting total radiation from the flame.

Temperature is not the entire answer. It must be combined with radiation. I think in the future, after some more study, a burner will be developed that will give us a flame with as high radiation using oil as that obtained in burning pitch.



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Ninety per cent or more of all steel mill lubricating installations in America are Bowser. There is, of course, a reason for this predominance.

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The real answer goes back to the fact that Bowser's staff of lubrication engineers know steel mill lubrication "from soup to nuts" and design every installation for its particular requirements. Bearing sizes, roller sizes, pressures, heat, all figure in the engineering. The lubrication unit becomes a tailor-made, integral part of the mill.

Bowser's engineering staff, with a background of 57 years of experience in industrial lubrication, is at your service. BOWSER, INC., Fort Wayne, Ind.

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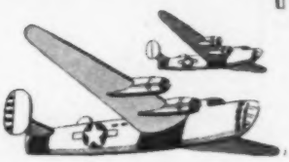
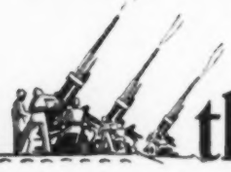
All of Hyatt's Production now goes into planes  our men fly ...into tanks they drive... into ships they sail...into guns  they man...into equipment they need to win.

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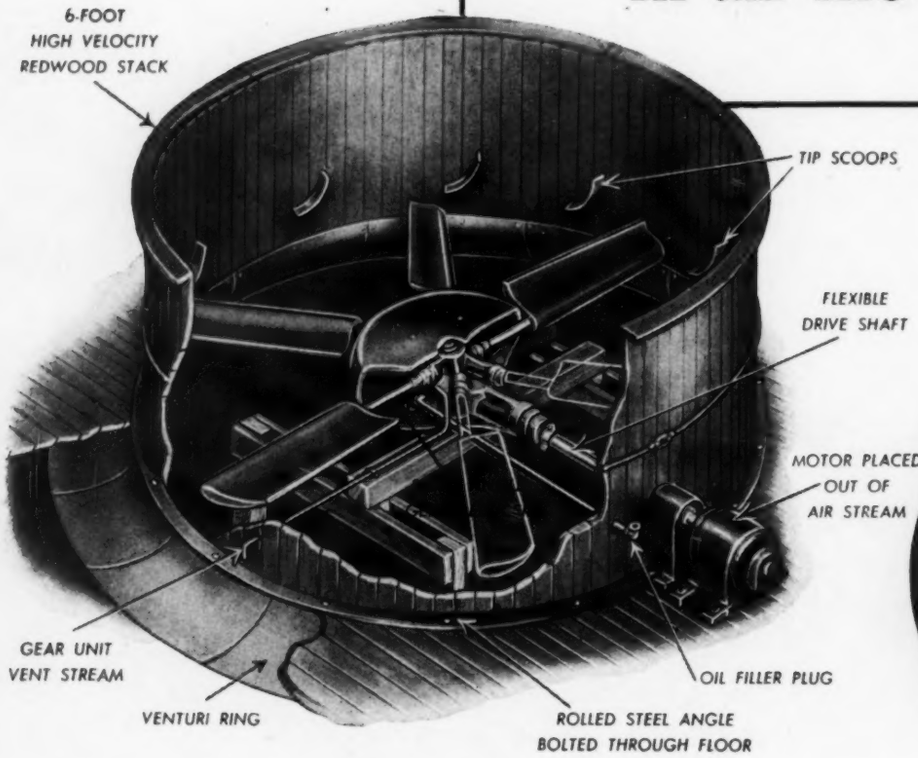

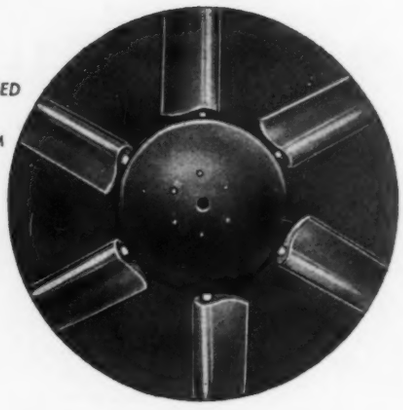

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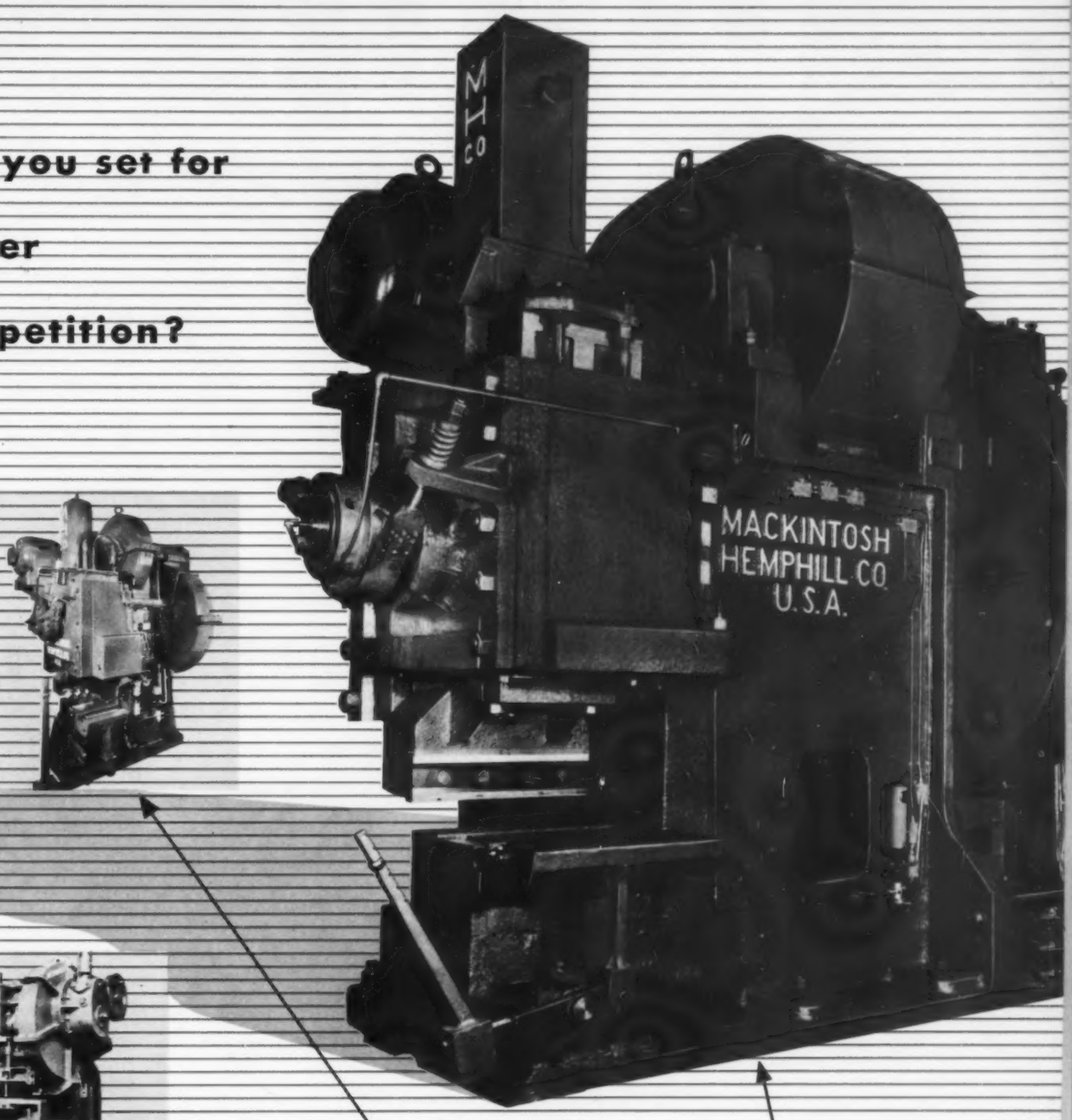

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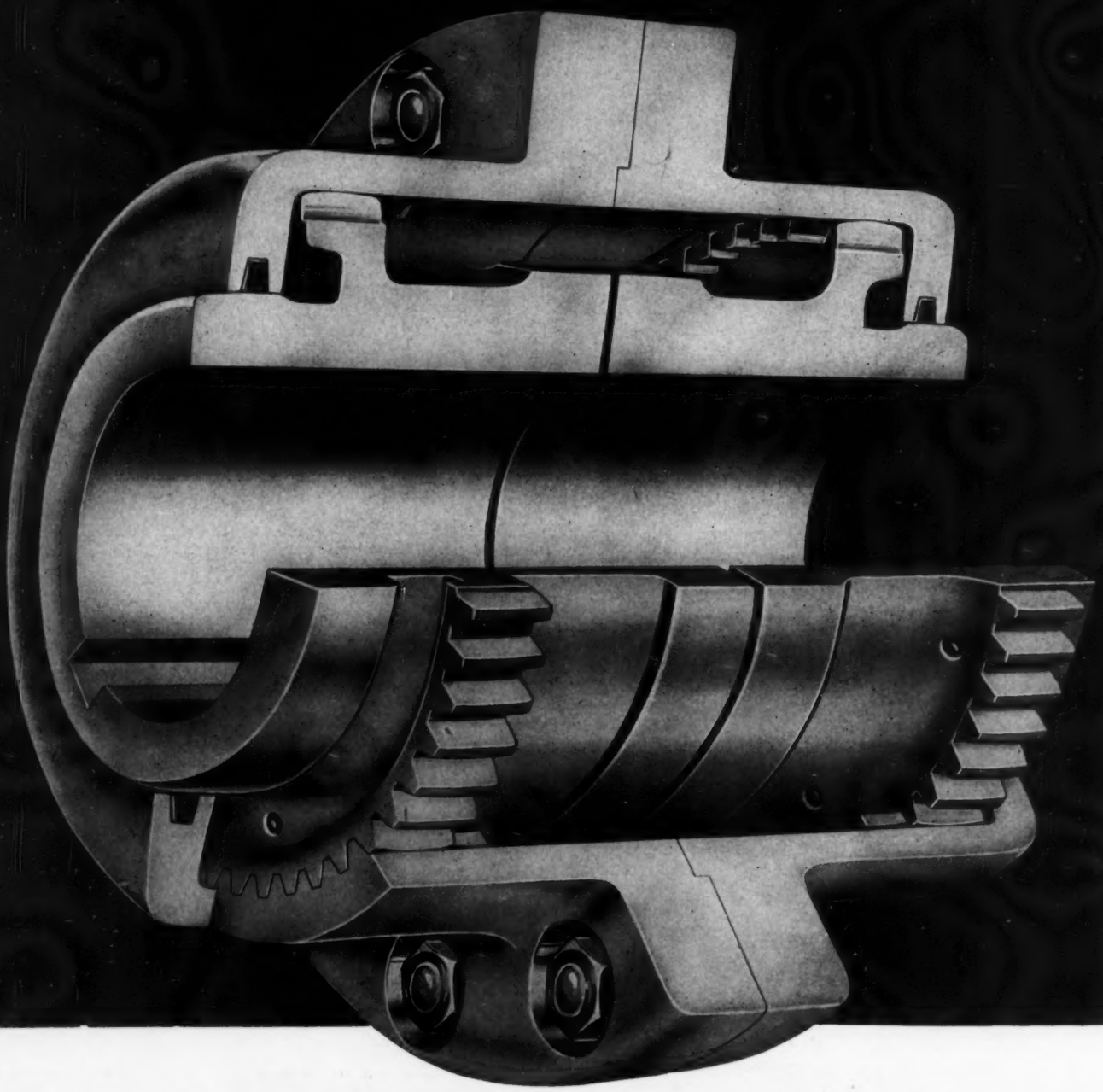

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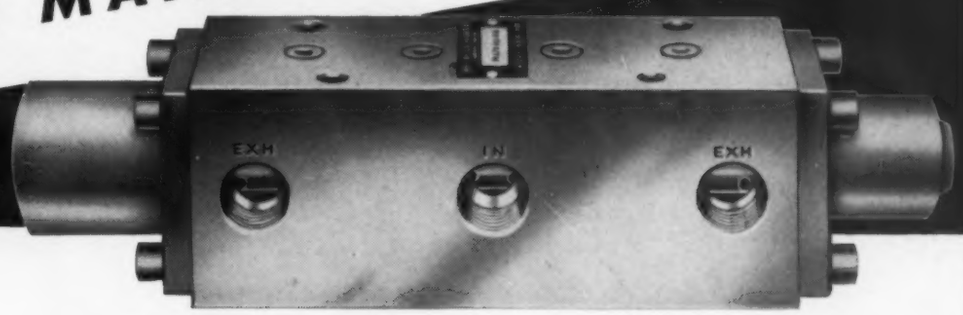

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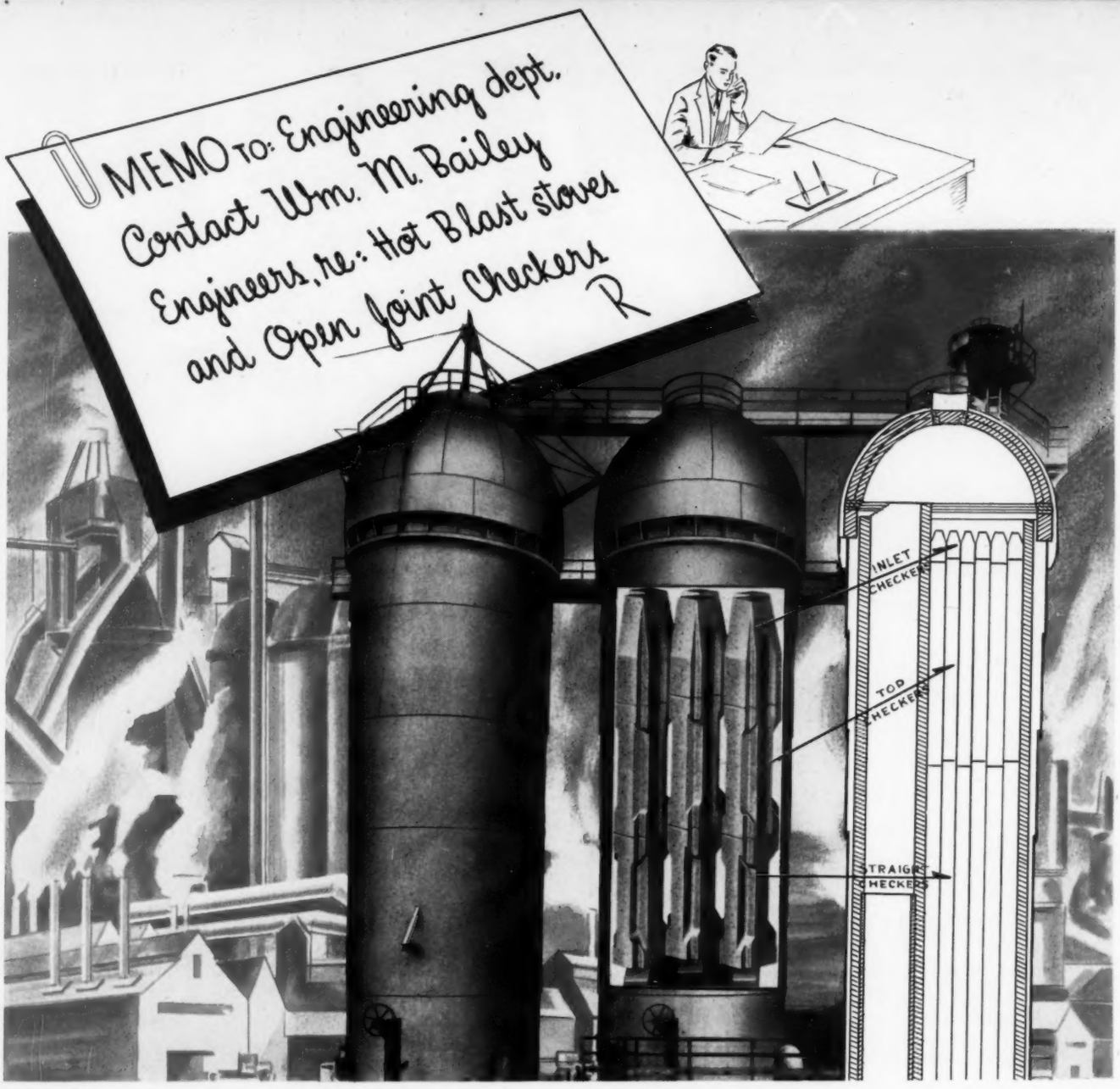

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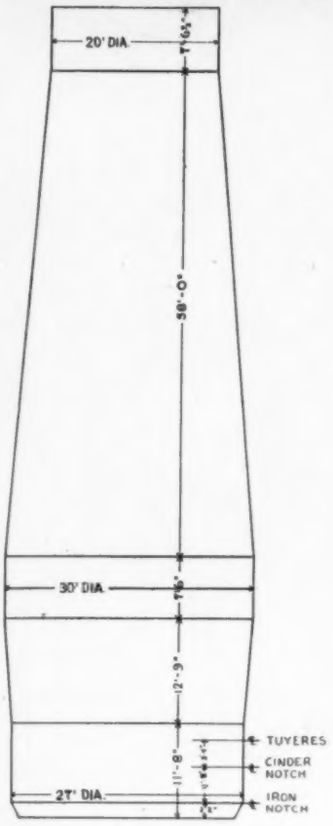


DPC *Blast Furnace* AT REPUBLIC CLEVELAND

▲ ANOTHER unit of the steel expansion program came into production in October with the lighting of a new blast furnace at Cleveland, Ohio. This is the third Defense Plant Corporation furnace to be put into operation by Republic Steel Corporation, who also constructed the plant for DPC.

The new plant consists of a blast furnace and auxiliaries, ore unloading dock, ore and limestone storage yard, stock trestle and bins, boiler and power house, pumping station and pig casting machine, located on the blast furnace site, and one battery of seventy-five coke ovens, with by-product and benzol plants located on a site adjacent to previously existing Republic coke ovens.

Ore is unloaded from boats at an unloading dock by two 17-ton unloaders, each capable of handling approximately 800 tons of ore per hour. The unloaders are equipped to automatically weigh and deliver ore into a storage pocket between the unloading dock and the ore storage yard.

A 15-ton ore bridge, with 275 foot span over the ore storage yard and cantilever spans over the unloading pocket and furnace stock bins, serves to place ore into storage, and from storage to stock bins via a 75-ton transfer car operating on top of the stock trestle. Limestone, received by boats equipped with self unloaders, is delivered directly into the storage yard, and then handled from storage to stock bins by the ore bridge and transfer car.

The storage yard, 275 feet wide by 750 feet long, provides storage capacity for approximately 500,000 tons of ore and 150,000 tons of limestone, sufficient to supply demands of furnace during the closed shipping season.

A scale car operating under the trestle stock bins weighs and delivers ore and limestone to the furnace skip cars. Coke is delivered from the coke plant in hopper cars to two coke bins located in the stock trestle at either side of furnace skip, from whence it is automatically screened, weighed and discharged into furnace skip cars. The furnace charging mechanism is automatically controlled from the stock house and interlocked to insure proper sequence of movements on the several component parts of the charging system.

The blast furnace has a hearth diameter of 27 ft, with 18 tuyeres, and is designed to produce 1300 tons of pig iron per day. The furnace will use approximately 2400 tons of iron ore, 1100 tons of coke, 550 tons of limestone and 85,000 cu ft of air per minute to produce this iron, which will be accompanied by 650 tons of slag, and 110,000 cu ft of blast furnace gas per minute.

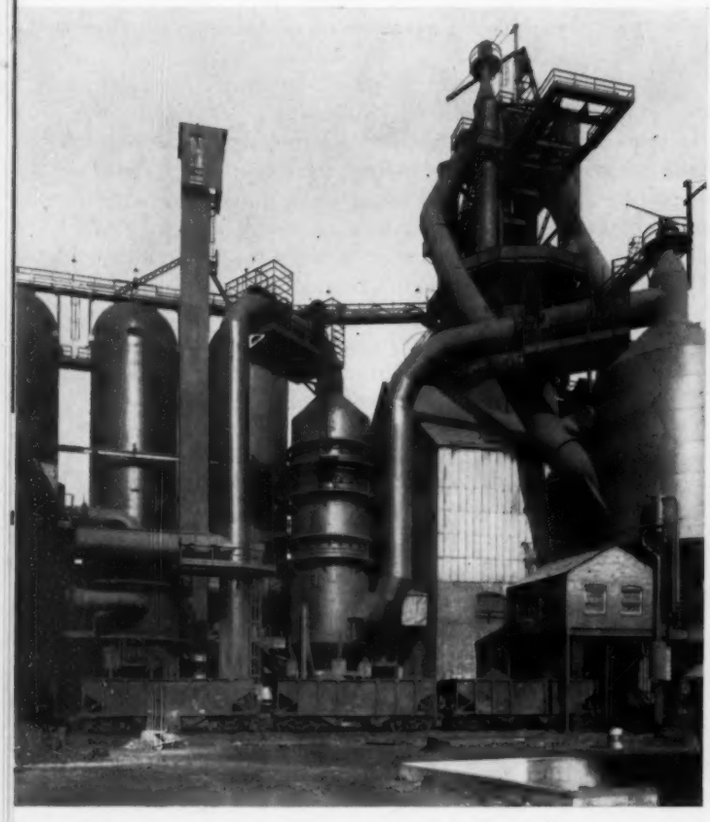
The furnace will average five casts per day, of 260 tons each, the iron being handled in two 165 ton mixer type ladles to open hearth furnaces for hot metal charging or to the pig machine for casting into pigs. The slag will be run into open slag pits adjacent to the cast house, and after solidification will be loaded into cars for delivery to slag processing plant.

Approximately 6,500,000 cu ft per hr of blast furnace gas, of 90 Btu per cu ft, is delivered from offtakes at the top of the furnace through two 7 ft diameter downcomers to dustcatcher, where a portion of dry dust entrained in gas stream is trapped out, thence up through tile baffles in gas washer where it counterflows with water spray of approximately 3000 gpm for further cleaning and cooling, thence through two electric precipitators for final cleaning.

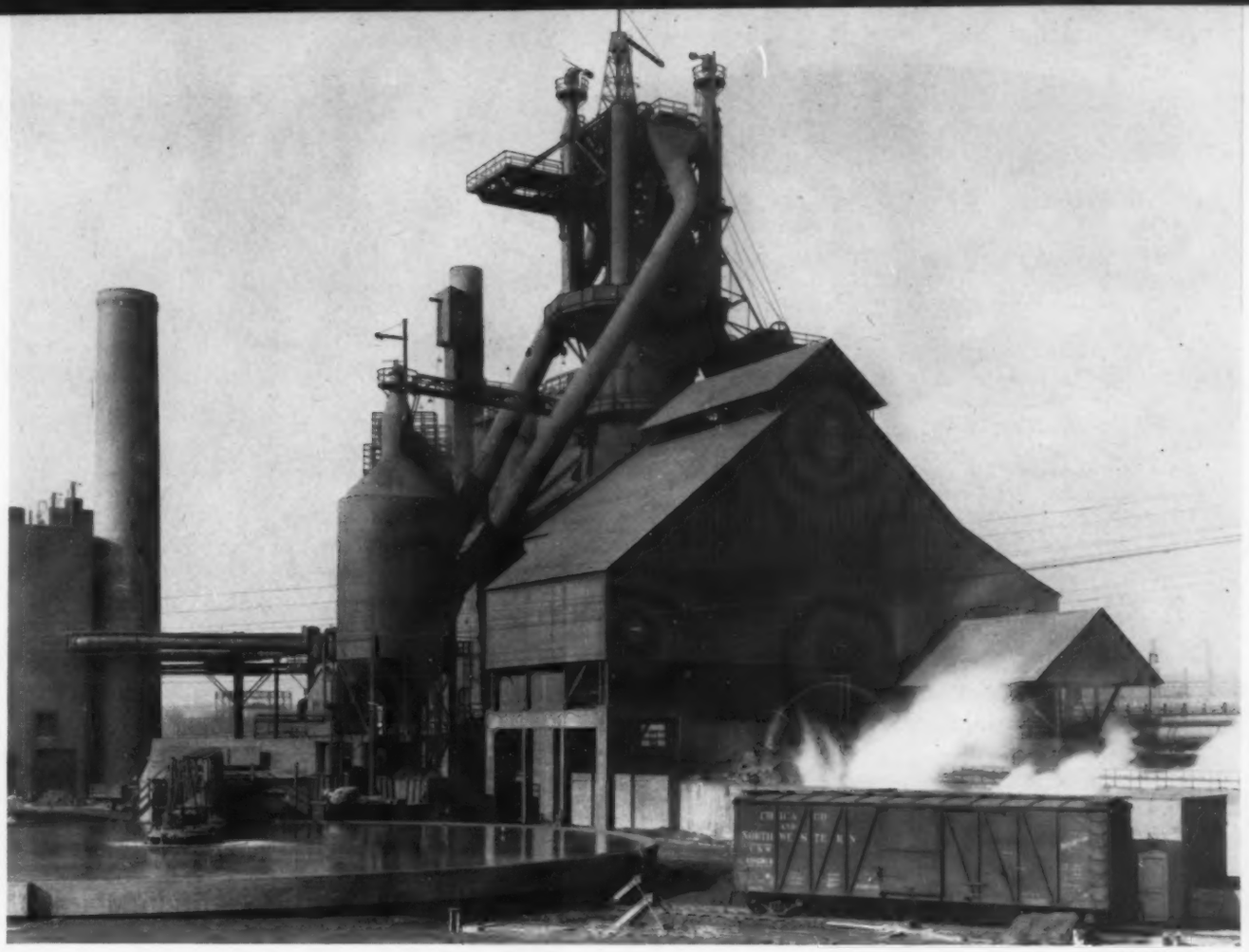
Approximately 25 per cent of the clean gas is used on three 25 ft diameter by 115 ft high stoves, each with approximately 200,000 sq ft of heating surface, for preheating blast air to the furnace. Approximately 1,800,000 cu ft per hour is delivered through a 54 in.

View showing Cuyahoga River, unloading dock and ore storage yard on right side. Plant entrance and main office in central foreground. Pig machine on left side. Blast furnace and power house beyond pig machine on left side.

With a hearth diameter of 27 ft, the furnace is designed to produce 1300 tons of pig iron per day. Each of the three stoves, which are 25 ft in diameter x 115 ft high, provide about 200,000 sq ft of heating surface.



Automatic furnace charging control, operated from this control panel, interlocks the operations of skip hoist, large and small bell hoists, revolving furnace top and charging car, insuring proper sequence of operations.



View of blast furnace, looking toward southeast corner of cast house. Slag pits on right side, thickener on left side with boiler house stack and northeast corner of boiler house in background. Dustcatcher immediately to left of cast house.

diameter gas main to the coke plant for underfiring the ovens, and the balance, approximately 3,000,000 cu ft per hour, is used for fuel on two 6000 hp boilers, each capable of evaporating 150,000 lb of water per hour to steam at 300 psi pressure at a temperature of 700 F. Approximately 300,000 lb of steam per hour will be distributed, 75,000 lb per hour going to the turbo-blowers supplying blast to the furnace, 50,000 lb per hour to boiler house auxiliaries, 25,000 lb per hour to the blast furnace, 100,000 lb per hour to the coke plant, and the balance to general plant use.

The pump house, located at the northwest corner of the site, is equipped with two 20,000 gpm pumps, one operating and one a spare unit, supplying water from the Cuyahoga River to the power house for use on surface condensers and for distribution to the blast furnace through two 7500 gpm service water pumps located in the power house and arranged to take water from the tail race of condensors. Approximately 3000 gpm of water circulated through the blast furnace coolers is recovered and recirculated through the gas washer. The water from the gas washer and precipitators is passed through the thickener for recovery of solids. A 12 in. city water main supplies approximately 1500 gpm of city water for boiler feed make-up, sanitary uses and fire protection. A second pumping station, located down river from the blast furnace site, equipped with two 5000 gpm pumps, supplies water from the Cuyahoga River to the coke plant.

Two 90,000 cfm at 30 psi turbo-blowers, one operating and one a spare unit, located in the power house, supply blast air for blowing the furnace. The blast air is heated to approximately 1400 F in the hot blast stoves.

The coke plant will consume 1700 tons of coal per day to produce 1200 tons of furnace coke, approximately 18,000,000 cu ft of 500 Btu coke oven gas per day, and other by-products such as tar, ammonium sulphate, benzol and motor fuel.

Electric power for the blast furnace and coke plant is furnished by the local utility at 11,000 volts, 3 phase, 60 cycle, and transformed at the power house to 2200 and 440 volts for a-c power and 115 volts for lighting. D-c at 250 volts is supplied through two 1500 kw synchronous motor generator sets located in the power house.

A company announcement sets up this furnace as one that will be watched with interest by the entire blast furnace fraternity. Plans have been made to run tests on this furnace, checking relations between flue dust and blowing rate, between hearth pressures and hanging of the stock column, etc. The furnace will be blown at the highest possible rates, up to a dust make of 350 lb per ton of iron. An automatically controlled valve is provided so that a study can be made of furnace operations with a top pressure of 5-10 psi. For this operation, the two turbo-blowers may be used in series operation, with an air cooler between. These tests, which will be run by professors and students of Case School of Applied Science under the direction of J. H. Slater, assistant district manager of Republic's Cleveland plant, are expected to develop much information of value to blast furnace operators.

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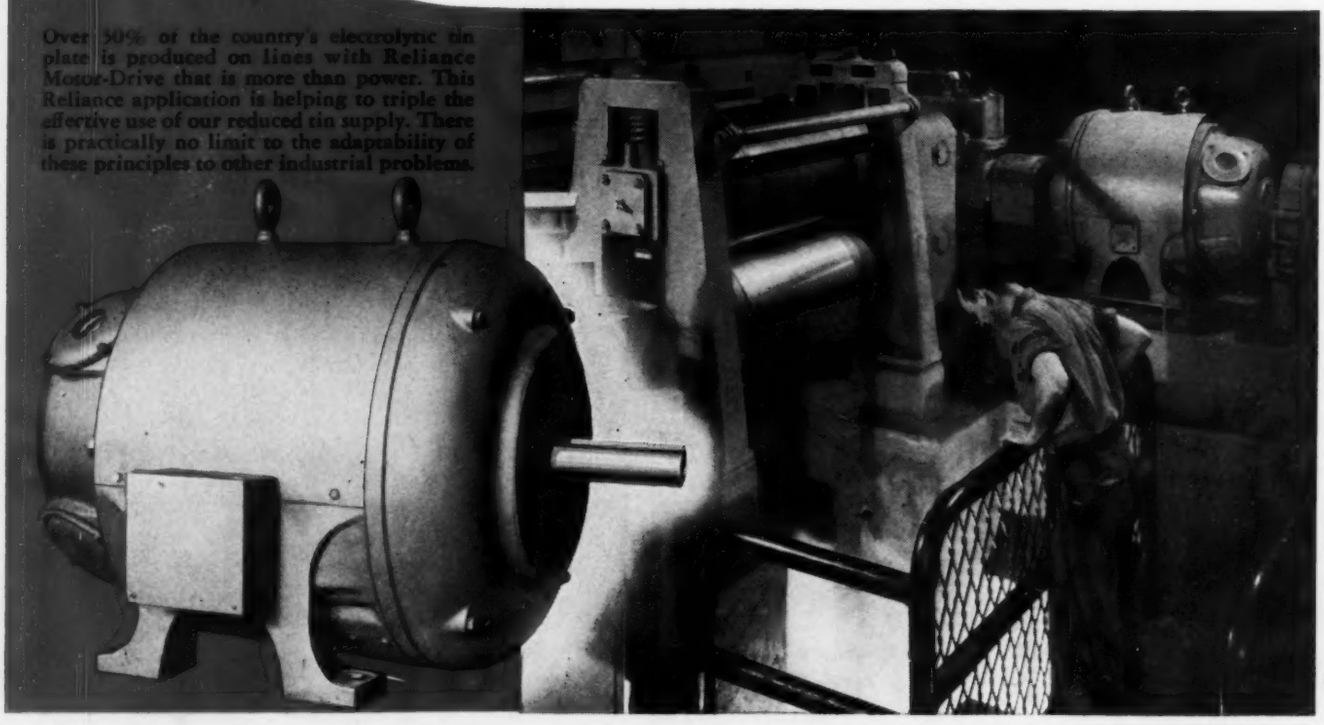

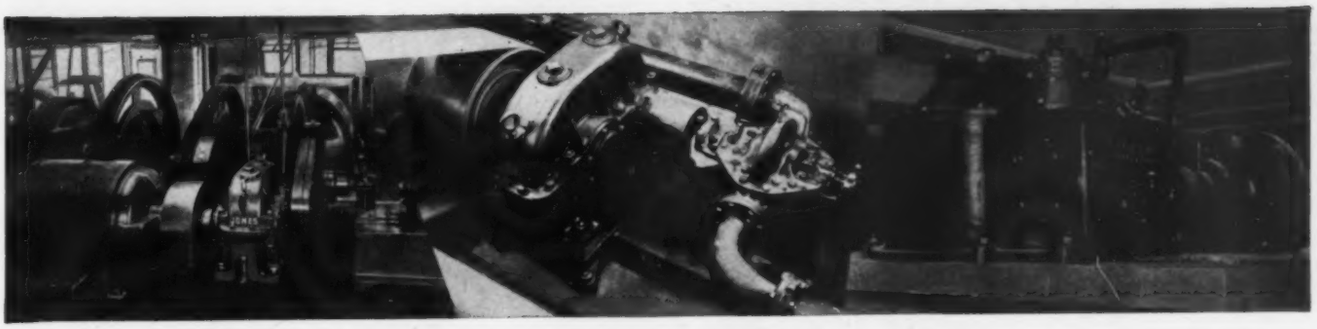

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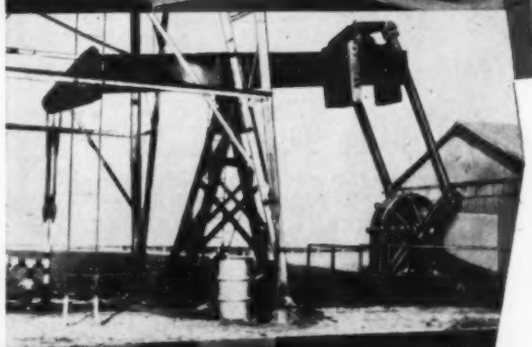

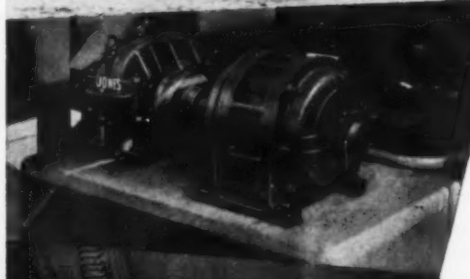

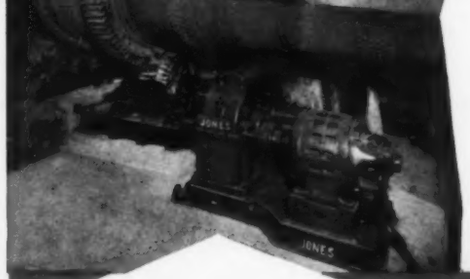

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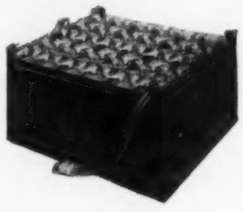


A few years ago, an Edison Alkaline Battery, operating an industrial truck in a New England railroad terminal, was retired from service as "worn out." It had passed the usual "retirement age" and was beginning to show signs of no longer having adequate capacity for the work.

So the electrician in charge issued instructions to have it crated and shipped back to our factory for scrap credit. The battery was crated but in some unaccountable manner was not shipped. Instead, it was sidetracked into a corner of a dead storage room where it remained unnoticed for more than a year.

By lucky coincidence it was discovered again at a time when the terminal happened to be short of industrial-truck batteries. It was uncrated, charged, and put into one of the trucks just to see what it could do. It did so well that it was kept in regular use and was not finally replaced with a new one until more than a year later.

What this incident illustrates, more than anything else, is the fact that even after an alkaline battery reaches the normal end of its useful service life, and no longer delivers its full rated capacity, it is still a dependable power source, not in the habit of failing unexpectedly. Some of the unique characteristics of the Edison Alkaline Battery which account for this great reserve of dependability are cited in the column at the right.

ADVANTAGES OF THE EDISON ALKALINE BATTERY IN INDUSTRIAL TRUCKS AND TRACTORS

★ It is durable mechanically. High strength steel construction is used in the containers, grids, pole pieces, etc. The electrolyte is a preservative of steel.

★ It is foolproof electrically. It may be accidentally short-circuited, over-charged, over-discharged, or even charged in the reverse direction without injury.

★ It can be charged rapidly. It is not subject to finish-rate limitations. It requires no equalizing.

★ It withstands temperature extremes. It is not damaged by freezing. Free air spaces on all sides of all cells provide ventilation for rapid cooling under high temperature conditions.

★ It is simple to maintain. Merely charge adequately, add pure water, keep clean and dry.

★ Its tray assembly and cell connections are extremely simple.

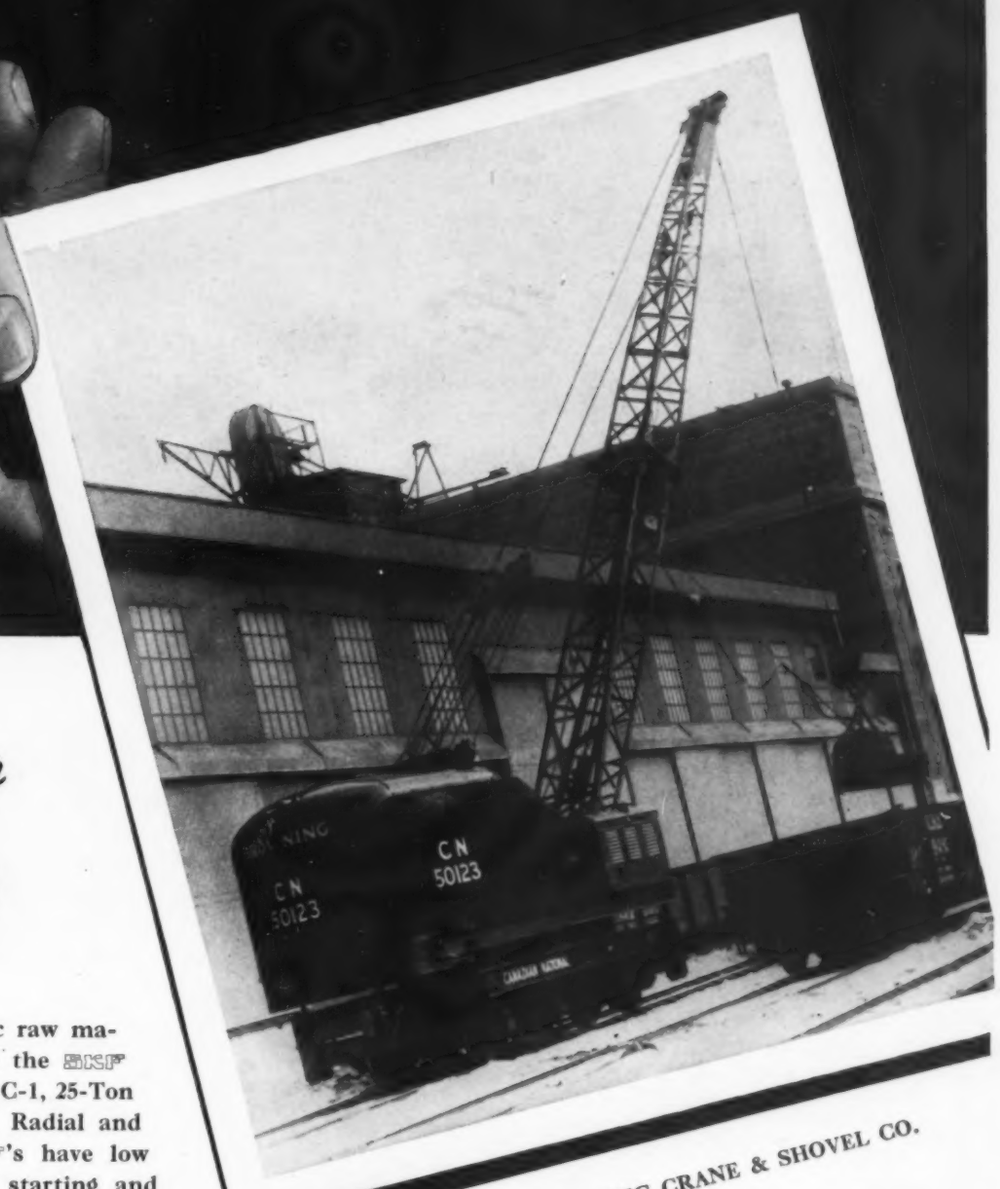
★ Its life is so long that its annual depreciation cost is lower than that of any other type of storage battery.

EDISON STORAGE BATTERY DIVISION, THOMAS A. EDISON, INCORPORATED, WEST ORANGE, NEW JERSEY

Edison

ALKALINE BATTERIES

A PICTURE OF SKF PERFORMANCE



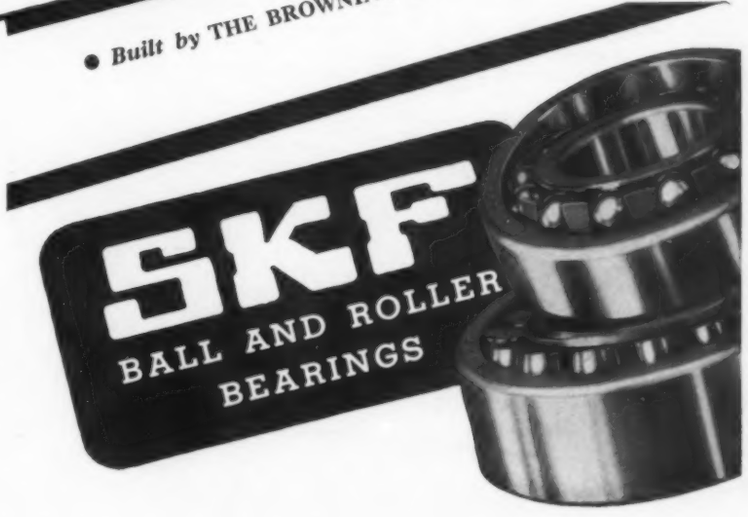
For a big

LIFT

The movement of strategic raw materials gets a big lift from the SKF Bearings on this Browning C-1, 25-Ton Diesel Locomotive Crane. Radial and thrust load carriers, SKF's have low friction that assures easy starting and running. Low lubricant requirements reduce maintenance to a minimum. Wherever there's an SKF, there's help for Industry to help America. 5521

SKF INDUSTRIES, INC., PHILA. 34, PA.

• *Built by* THE BROWNING CRANE & SHOVEL CO.



EXIDE-IRONCLADS MEAN EXTRA EFFICIENCY IN MATERIALS-HANDLING

Fast-moving, battery-powered electric trucks are speeding up loading, unloading and load-shifting throughout industry . . . with less waste of manpower. They also are speeding production by permitting women to handle jobs heretofore considered too heavy. In this efficient, stream-lined system of materials-handling, Exide-Ironclad Batteries are widely recognized as a source of never-failing power . . . extra efficiency for an already highly efficient operation. Exides have long been known for their dependability, long-life, and ease of maintenance. The steps you take to modernize with Exides mean economies that are yours for years to come. When you buy an Exide, you *Buy to Last*. Take care of it and *Save to Win*.

ARMY E NAVY

Exide
IRONCLAD BATTERIES

EXIDE-IRONCLAD BATTERIES OFFER THREE VITAL POINTS OF SUPERIORITY

MORE POWER, MORE PRODUCTION: An Exide-Ironclad delivers its power at uniform voltage to assure constant hauling speeds. There is always a giant surge in reserve when an Exide powers your battery propelled vehicles.

LONG-LIFE SAVES MATERIALS: Every Exide is built to last, and saves vital materials by squeezing the last ounce of use out of the materials in it. When you buy an Exide, you definitely . . . Buy to Last and Save to Win.

EASY MAINTENANCE, SAVES LABOR: Exides are kept charged by the simplest method ever devised. With the Exide Charge Control Unit all you do is connect battery to the charging source and turn a knob.

THESE RULES PROMOTE GREATER BATTERY EFFICIENCY:

1. Keep adding approved water at regular intervals. Most local water is safe. Ask us if yours is safe.
2. Keep the top of the battery and battery container clean and dry at all times. This will assure maximum protection of the inner parts.
3. Keep the battery fully charged—but avoid excessive over-charge. A storage battery will last longer when charged at its proper voltage.
4. Record water additions, voltage, and gravity readings. Don't trust your memory. Write down a complete record of your battery's life history. Compare readings.

If you wish more detailed information, or have a special battery maintenance problem, don't hesitate to write to Exide. We want you to get the long-life built into every Exide Battery. Ask for booklet Form 1982.

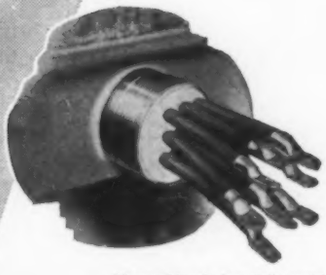
THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

Wagner

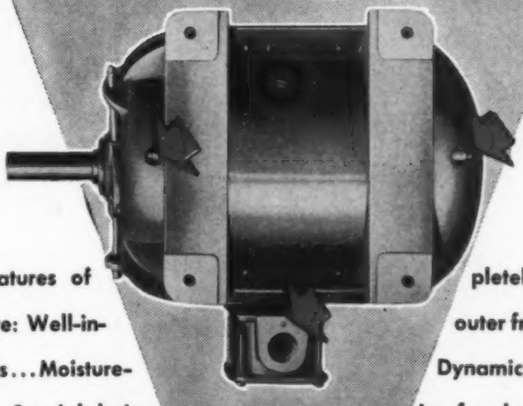
CHEMICAL-PROOF MOTORS

RESIST THE DAMAGING ACTION OF ACIDS, FUMES, MOISTURE, AND OTHER DESTRUCTIVE ELEMENTS

Below—Moisture-proof and dust-tight conduit box—screw-on type.



Above—Nipple is solidly welded into side of motor. Flexible compound completely seals lead wire openings.



Right—Special drain plugs in endplates and conduit box provide for the removing of any condensation.

OUTSTANDING construction features of Wagner Chemical-Proof Motors are: Well-insulated and impregnated windings... Moisture-proof and dust-tight conduit box... Special drain plugs in endplates and conduit box... Totally-enclosed, fan-cooled construction—inner frame completely seals windings and bearings, while outer frame guides cooling draft over motor... Dynamically-balanced (running balance), insuring freedom from vibration... Sealed cartridge-type ball bearings.

Write for Complete Literature...

For full information on Wagner Chemical-Proof Motors consult the nearest of Wagner's 29 Branch offices, located in principal cities and manned by trained field engineers.

Wagner Electric Corporation
ESTABLISHED 1891
6483 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

MOTORS
TRANSFORMERS
UNIT SUBSTATIONS
INDUSTRIAL BRAKES
BRAKE LINING

NATIONAL SECURITY AWARD

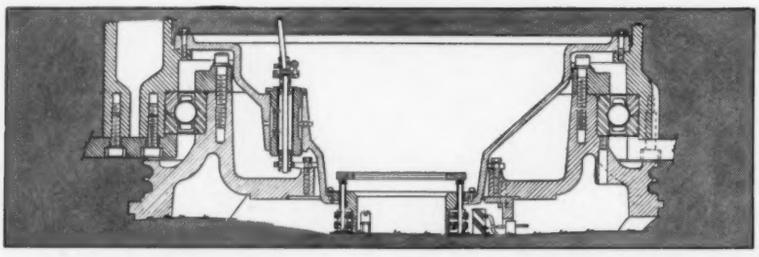
ARMY E NAVY

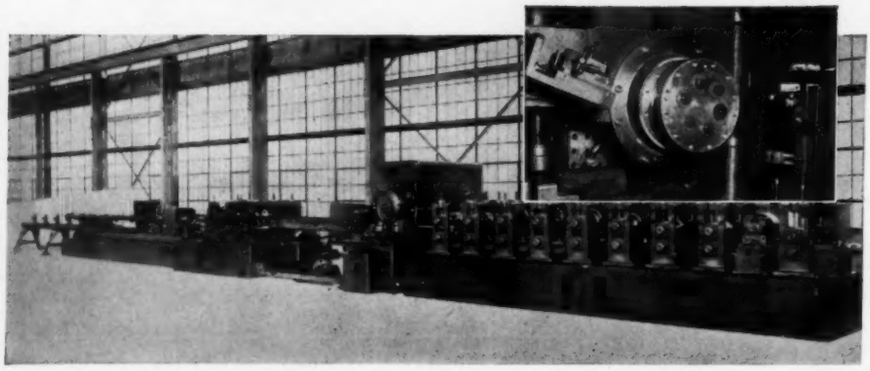
M44-5B

BACK THE ATTACK - - BUY U.S. WAR BONDS

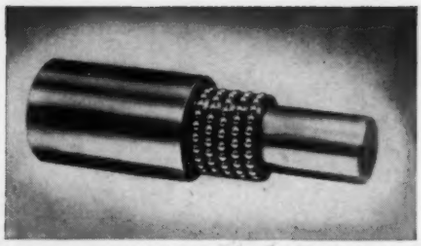
IN THE NEWS
WITH TORRINGTON BEARINGS

SIMULATING FLIGHT CONDITIONS, the Celestial Navigation Trainer, designed and built by Link Aviation Devices, Inc., provides operational flight crew training for navigators, bombardiers, radio operators and pilots. A fuselage which is a reproduction of a bomber nose is mounted on a universal joint and can duplicate the bank, pitch and turn of a plane under normal instrument flight. A large, 23-inch diameter ball radial bearing, supplied by Torrington's Bantam Bearings Division, helps support the fuselage, enables it to rotate with anti-friction ease and smoothness in response to the pilot's touch on controls. Photo above shows "terrain" as seen by navigator or bombardier.

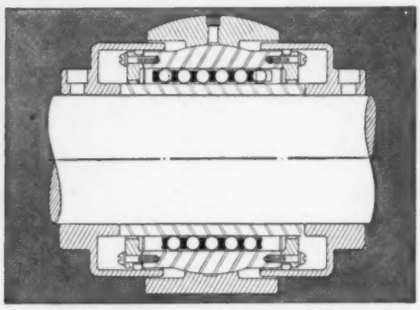




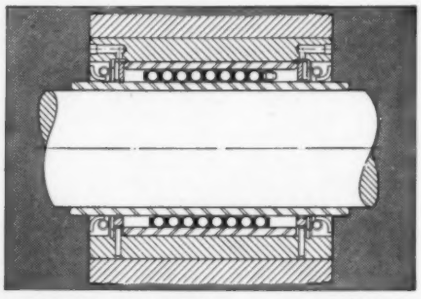
"FROM STRIP TO TUBING" describes the function of this 500 KVA Tube Welding Machine designed and built by The Yoder Company for feeding flat strip steel in, taking finished tubing out. Main electrode support shown in inset, rotates on a special 20" O.D. ball radial bearing supplied by Bantam for this "out-of-the-ordinary" application. Anti-friction bearings in every major type and in sizes up to 10 *feet* in O.D. are supplied by Torrington's Bantam Bearings Division. If you have a difficult or out-of-the-ordinary bearing job, TURN TO TORRINGTON for experienced assistance.



(1) NEW TYPE BALL RECIPROCATING BEARING that offers unusually high capacity is now available. Designed by engineers at the Bantam Bearings Division of The Torrington Company, this new anti-friction unit has a "spirally wound" retaining cage containing a full complement of balls over a long axial distance, and provides more than double the contact than heretofore available in a reciprocating bearing.



(2) NEW APPLICATIONS are expected from this new high capacity unit which offers the design engineer several advantages over the type formerly available. This X-section shows a typical mounting suggested for printing press inking rolls, designed to eliminate possibility of oil leakage.



(3) OTHER APPLICATIONS are expected to be found in engine governors, welding machine guides, doctor blades, coating machines, spool winders, buffers, polishers, etc. A number of methods of mounting are suitable, depending on existing design factors. A second suggested type is shown here.

A FULL RANGE OF NEEDLE BEARINGS to meet virtually any radial load requirement is included in the Torrington-Bantam line, as well as all major types of tapered roller, straight roller and ball bearings. Our engineers will be glad to work with you in selecting the right type for your requirements. Join the TURN TO TORRINGTON for your bearing needs.

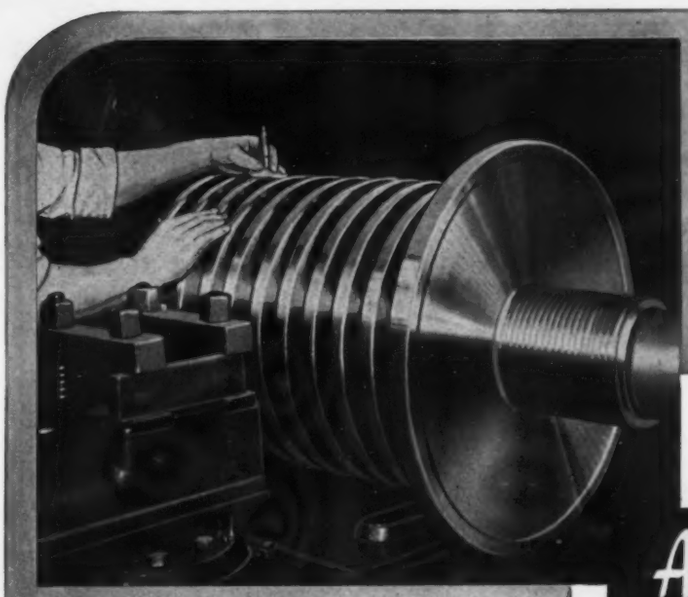
ARMY E NAVY

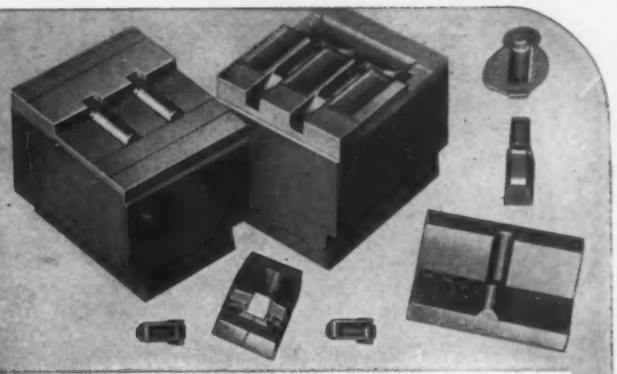
TORRINGTON BEARINGS

STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL

THE TORRINGTON COMPANY · BANTAM BEARINGS DIVISION

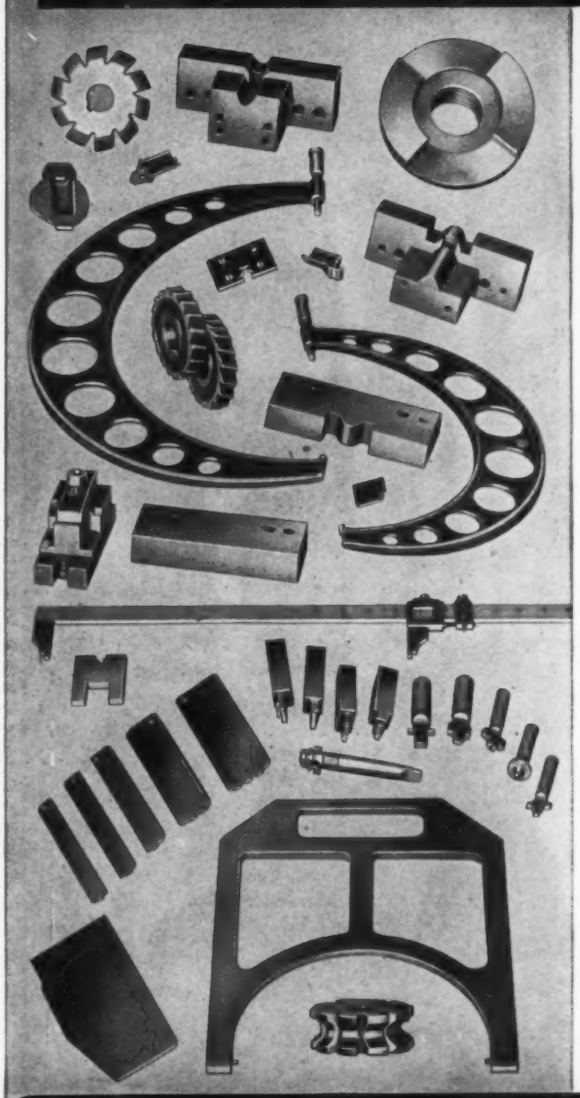
SOUTH BEND 21, INDIANA





Special tools, gages, jigs and templates used in the production of the integral steam turbine rotor shown.

A Manufacturing Policy THAT HAS STOOD THE TEST OF TIME



From its inception in 1901, the De Laval Steam Turbine Company has recognized that the best results are obtainable only by confining the work of its staff to the development, design and production of a single class of manufacture, having the same general characteristics and requiring the same processes and high grade of workmanship. Consequently the efforts of the company have been confined to high-speed rotary power equipment, including STEAM TURBINES, HELICAL and WORM SPEED REDUCING GEARS, CENTRIFUGAL PUMPS and COMPRESSORS and ROTARY OIL PUMPS.

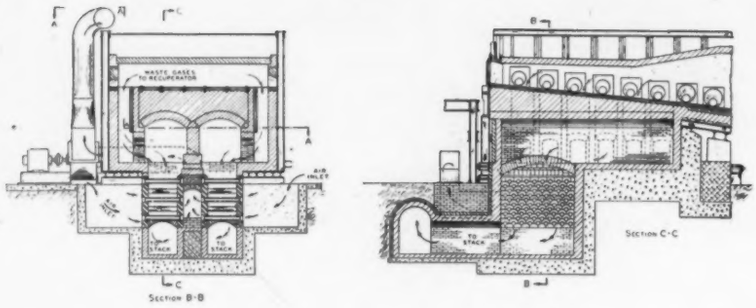
The jigs, tools and gages required for the production of high-grade work are much more expensive and elaborate than are those necessary for work requiring less refinement and care in manufacture. Also, the type of shop employee who can perform this accurate work is entirely different from that required for less particular and accurate classes of work.

M-29

De Laval STEAM TURBINE CO.
TRENTON 2, N.J.

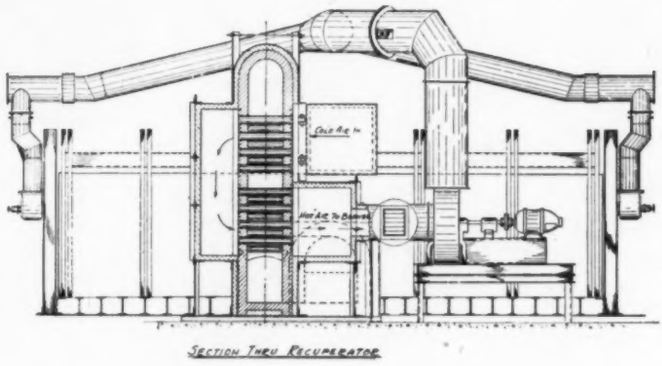
MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER; PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL; and FLEXIBLE COUPLINGS

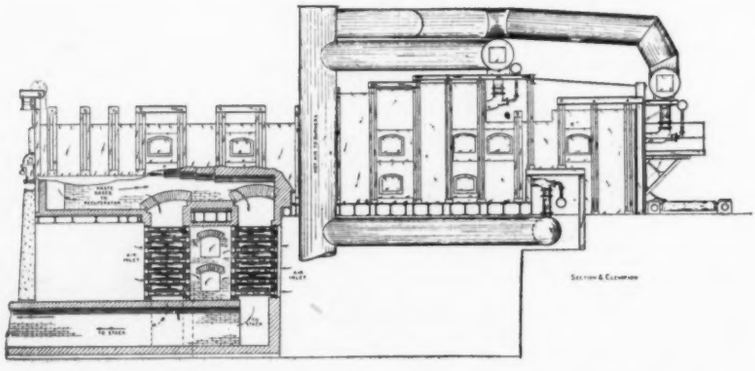
"FITCH" RECUPERATORS for HEATING FURNACES



Continuous Billet Heating Furnace

Batch Type Slab Heating Furnace





Continuous Slab Heating Furnace

WE DO NOT BUILD FURNACES

Write for Bulletin No. 12

"FITCH" RECUPERATORS for the STEEL INDUSTRY

FITCH RECUPERATOR COMPANY

PLAINFIELD NATIONAL BANK BLDG. PLAINFIELD, NEW JERSEY

NEWS SUPPLEMENT *March 1944*

Equipment
Personnel
Literature

Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

WEIRTON CONTINUES RECORD-BREAKING OPERATIONS

▲ All-time plant records for average daily production of finished steel for shipment, strip mill production and blooming mill production, were established in February by the Weirton Steel Company, it is announced by the Weirton Steel Company labor-management committee.

The new daily average record for production of finished material of 5196 tons compares with the previous record of 5103 tons. Strip steel was produced at the rate of 4116 tons per day against a previous record of 4023 tons, while the average daily blooming mill production was 4859 tons against a previous record of 4715 tons.

The 10 in. mill, which was one of those that helped to set the new record in the strip steel department, actually rolled more tonnage during the 29 days of February than was ever rolled on this mill in any previous month.

The new records add to a long list established by the Weirton Steel Company since the beginning of the war. The first record to be broken after Pearl Harbor was for ingot production. This was in March 1942 when a new monthly record was established by the production of 153,733 tons. Following this, new monthly and average daily records for ingot production were set on five separate occasions, the latest having been in May 1943 when a new high mark was registered with the production of 168,207 ingot tons in that month. The increased supply of ingots plus the determination of employees resulted in the breaking of scores of department records in all plants of the Weirton Steel Company.

Spokesmen for the Labor-Management Committee pointed out that these production records are merely crests on the high wave of production that has been maintained since the start of the war and which has produced a continuous flow of steel for the support of our armed forces.

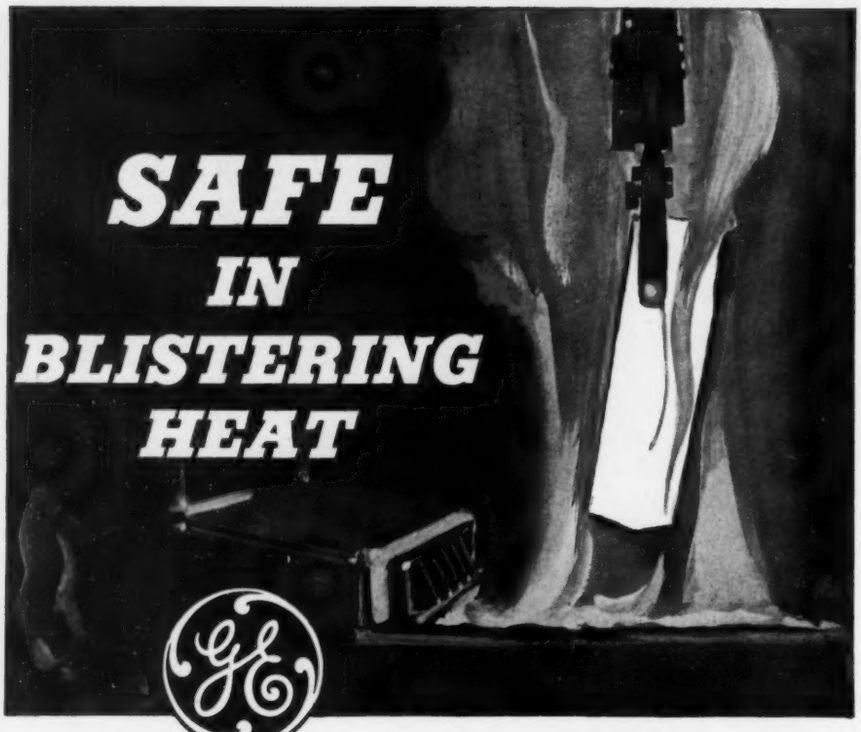
In addition to high steel production, the Weirton Steel Company and its employees made a notable contribution to the war program last summer when it developed methods for rolling brass on steel equipment. This feat had been considered impossible both inside and outside of the steel industry. The successful production of brass at Weirton helped to break a bottleneck in the supply of this material at a critical time.

REPUBLIC SETS NEW RECORDS IN FEBRUARY

▲ Operating at 103.5 per cent of capacity for February and 102.9 per cent of capacity for the year to date, Republic Steel Corporation in two months of 1944 has produced a total of 1,427,020 tons of steel ingots as compared with a previous high of

CRANE COMMITTEE INVESTIGATES COLD RIVETING

Members of the Crane Committee of the Association of Iron and Steel Engineers recently witnessed a demonstration of cold driven riveting at the Graham Works of Pittsburgh Screw and Bolt Corporation. Cold driving, with correct pressures as determined for the rivet size and material, has been shown to cause the rivet to completely fill the hole, thus giving a tight joint and at the same time increasing the rivet strength. In the photograph, W. E. Fowler, Jr., of Riveting Apparatus, Inc., is explaining the Osborne automatic pressure control which accurately regulates the pressure applied to the rivet. The desirability of cold driven rivets in the construction of laminated ladle hooks is being investigated by the Crane Committee.



DELTABESTON CABLE

Deltabeston Asbestos-insulated Wires and Cables fortify electrical circuits where high ambient temperatures and severe operating conditions prevail. Mill and mine superintendents know from experience that Deltabeston Types AVA or AVL won't bake out in blistering, hot installations such as around soaking pits, boiler rooms, furnaces and in other torrid zones. That's why they choose Deltabeston. They know there's no substitute for it where heat is the important factor.

Deltabeston Asbestos-insulated Power Cables are saving many hours of maintenance time in steel mills, mines and power plants where scorching heat ruins ordinary power cables. Here's how Deltabeston Type AVA is provided with *plus* protection against power failures:

1. Copper Conductor is centered perfectly providing uniform thickness of the insulating wall.

2. Impregnated felted asbestos—a heat-barrier for protection against high conductor temperatures.

3. Varnished cambric for moisture resistance and high diaelectric strength.

4. Felted asbestos—for plus protection against ambient heat.

5. Asbestos braid—for high resistance to heat, moisture, oil, grease and corrosive vapors.

For additional information write for this catalog. Send your request to Section Y 341-31, Appliance & Merchandise Dept., General Electric Co., Bridgeport, Conn. Deltabeston Asbestos-insulated Wires and Cables are distributed nationally by Graybar Electric Co., G-E Supply Corp. and other G-E Merchandise Distributors.

GENERAL ELECTRIC

1,348,056 tons produced in the same period of 1943.

The Warren blast furnace exceeded its all-time monthly record with a production of 42,414 tons of pig iron, beating December 1943 by 112 tons, in spite of the fact that December was a 31-day month and February a 29-day month. On a 31-day basis the furnace would have produced 45,353 tons of pig iron. The daily record was broken twice during February—first for February 2 with 1660 tons, and next on February 21 with 1675 tons.

Republic's record daily average production of electric furnace steel was also exceeded with a total of 3220 tons compared to 3181 tons, the previous record daily average established in May, 1943.

The Gadsden (Alabama) plate mill broke all records with a production of 26,284 tons of steel plate as compared to 26,240 tons in January of this year.

The Port Henry division of the Adirondack district exceeded its January 1944 record of 120,972 tons of crude by mining 127,209 tons in February.

NATIONAL TUBE USES NEW DEOXIDIZING METHOD

▲ Bessemer steel, the product of flaming sentries which for many years have served as landmarks in various steel districts, is coming back into its own.

According to E. C. Wright, assistant to president, National Tube Company, new and wider uses for Bessemer steel are being found, due to the development of improved controls by metallurgists of this U. S. Steel subsidiary.

In a paper read recently at the annual meeting of the American Institute of Mining and Metallurgical Engineers in New York, Mr. Wright discussed the development of "killed" Bessemer steel, a process which thoroughly deoxidizes the steel, making it comparable in quality to the product of the more widely used open hearth process.

In the experiments described by Mr. Wright, leading to more effective controls of this type of steel through deoxidation, it was developed that phosphorous and nitrogen in the

amounts ordinarily present in Bessemer steel do not hinder its wider use, providing deoxidation was thoroughly brought about.

As a matter of fact, Mr. Wright pointed out that maximum sulphur and phosphorous requirements established at least 25 years ago today have an arbitrary and archaic tinge, inasmuch as at the present time sulphur is being added to many open hearth and Bessemer steels in amounts far exceeding the maximum sulphur content normally found in Bessemer steel, and also that rephosphorizing is widely practiced for specific applications.

"In the case of nitrogen, it has lately been learned that many high grades of electric furnace steels have considerable amounts of this element," he said, adding that nitrogen is introduced in certain open hearth heats of steel and has been useful in regulating heat-treatment and grain-size control. He pointed out that Bessemer steel "has been condemned frequently, and one may say erroneously, because of its higher nitrogen and phosphorous content."

The "killed" process was outlined as one in which a blown converter bath is treated by additions of hot metal (iron) containing approximately 4 per cent carbon, as well as some manganese and silicon.

The Bessemer heats so treated were found to be thoroughly "killed" and of good forging quality. They could be teemed into regular hot-top ingot molds, rolled into tube rounds and satisfactory seamless tubes with practices equaling results obtained on open hearth steels.

LARGEST CHICAGO CROWD OF YEAR HEARS BEYNON

Ross E. Beynon, Carnegie-Illinois Steel Corporation, South Chicago, Illinois (shown at right top, center, with R. H. Scholl and A. E. Day, of Pittsburgh Rolls Division, Blaw-Knox Company) presented a paper on "The Rolling of Semi-Finished Material" at the March meeting of the A. I. S. E. Chicago District Section. Among the 250 in attendance were (right center, standing) S. T. Ball, of Youngstown Sheet and Tube Company, G. N. Herman, Continental Roll and Steel Foundry Company, and C. A. Matirko, Open Hearth Combustion Company, and seated, G. W. Abel, Youngstown Sheet and Tube Company, and Oliver Davis and W. J. Siedlitz, both of Revere Copper and Brass Company. An added attraction, through the courtesy of R. B. Kraft, Lewis Foundry and Machine Division, Blaw-Knox Company, was the champion barbershop quartet, the Four Harmonizers, shown at right bottom.

"Increase Mill Efficiency with SCHLOEMANN MOTOR-ROLLERS"

FREE access is permitted along both sides of "Motor-Roller" tables. Obstructions to the table in the form of space-consuming line shafts, gear reduction units and couplings are eliminated.

The squirrel cage motor contained within each roller with no electrical connection to the rotor represents the simplest means of converting electrical energy into mechanical power.

Schloemann "Motor-Rollers" are rugged in construction and dependable in performance. Each installation is specifically engineered and designed for your particular requirements.

★ ★ ★

SCHLOEMANN
ENGINEERING CORPORATION

1102 EMPIRE BUILDING . . . . . PITTSBURGH, PA.

HYDRAULIC PRESSES • ROLLING MILL MACHINERY

The seamless pipe process, which involves the piercing of a solid billet of steel to produce a pipe of uniform wall thickness, is in itself a very difficult forging operation and requires a billet of uniform density and forging characteristics.

In his paper Mr. Wright summarizes six important conclusions which have been drawn from the work in this field, conducted by metallurgists of National Tube Company, and which are quoted as follows:

1. The yield strength and fatigue properties of killed bessemer steel are superior to those of open hearth steel of the same tensile strength.
2. The ductility and toughness of the killed bessemer steel both at room and sub-zero temperature is equal to the ductility and toughness of open hearth steel of the same tensile strength provided both steels are thoroughly killed with the same deoxidation practice.
3. The ease of welding and metallurgical effects adjacent to welds of the killed bessemer steel are better than for open hearth steel of the same tensile strength.
4. The cleanliness and carburizing qualities of killed bessemer steel are equal to those of corresponding open hearth grades.
5. The susceptibility to strain or strain-aging and the amount of blue-heat brittleness developed by killed bessemer steel is similar and approximately equal to the strain-aging or blue-heat brittleness of killed open hearth steel of the same tensile strength, finished with the same deoxidation practice.
6. The creep strength of the fine-grained killed bessemer steel is higher than the creep strength of fine-grained open hearth steel finished with the same deoxidation practice.

FILTER FOR TRANSFORMER AND LUBRICATING OILS

▲ A new line of YM "Robot" oil refiners, designed to clean lubricating oil with continuous and automatic operation, has been announced by the Youngstown Miller Company, Sandusky, Ohio.

This machine, which is said to add new efficiency, convenience and economy to the widely used YM process of cleaning oil, utilizes common refinery earths available on the open market. It is capable of removing fuel dilution, acids, solid and colloidal carbon, dirt and similar matter; also,

STRAIGHTENING AND COLD FORMING DISCUSSED AT PITTSBURGH MEETING

Presidents came in bunches at the March meeting of the A. I. S. E. Pittsburgh District Section, when Walter Siegerist, president of the Medart Company, and Carl M. Yoder, president of the Yoder Company, presented papers. The authors are shown (extreme left and right, respectively) with C. H. Williams, chairman of the Pittsburgh Section, and C. L. McGranahan, president of the Association of Iron and Steel Engineers. Among those attending were Ross McLaren, superintendent of tube mills, Timken Roller Bearing Company, and H. E. Engelbaugh, assistant general superintendent of Campbell Works, Youngstown Sheet and Tube Company.

PURDY PIX

it can restore oil emulsified by water. When piston varnish and sludge deposits are present, the manufacturer offers a guarantee on removing them and preventing recurrence.

A single machine of this type can be installed to serve an entire power plant, whether large or small. Ability to restore transformer oils to 30,000 volt dielectric strength is also claimed for this machine.

This rapidly growing company is the well-known builder of machines that are in wide service today reclaiming oils from diesel engines, aircraft engines, hydraulic cylinders, ice machines, vacuum pumps, gasoline engines and similar installations. All models are designed to restore used oils to substantially the same fire, flash, viscosity, color, neutralization number and precipitation number as the new parent oil.

BRAZIL TO OPEN LARGE ORE DEPOSIT

▲ Installation of power and industrial equipment this year at Caue peak, Brazil, center of the world's largest iron ore deposit, will open up an important new source of ore for United Nations war plants, the International General Electric Company has announced.

Described as "the greatest known hard-ore mass, and easy to equip, develop, and mine," the area contains an estimated 15 billion tons of ore suitable for high-grade steel. Beginning this year and continuing for three years, annual production of one and a half million tons of ore will be divided between the United States and Great Britain.

The peak is located in the center of the iron region of the province of Minas Geraes and rises 4500 feet above sea level. The peak has no overburden of earth, and open pit mining, with drilling and blasting, will begin near the top. Two large electric shovels, powered by General Electric drives, will load the ore into trucks which will carry it three-quarters of a mile down a fairly steep road to the processing plant.

The trucks deposit the ore in a primary crusher, from which it passes down six conveyor belts in tandem over a mile long to two secondary crushers. After passing through several sorting and screening stages, the ore is conveyed to a hopper which loads it into railroad cars. G-E is completing 24 motors ranging from five to 350 horsepower to drive this equipment, and switchgear to control it.

At the crushing and screening plants, G-E will provide a 2000-kva transformer and other electric equipment in each of two substations feeding power to mine operations. A 69-kilovolt transmission line is being built to Peti, a 4500-kilowatt hydroelectric station 45 miles away, where G-E will furnish a 3700-kva transformer. Another power source will be a 1000-hp steam and diesel generating plant already operating at Bello Horizonte, now linked with Peti, about 35 miles distant.

The railroad from Itabira, the location of the mine, to the Atlantic ocean port of Victoria, 350 miles away, is being rerailed and rehabilitated and bridges of the railroad are being renewed in most cases and in others strengthened.

CONTINUOUS RECORDER FOR GAS ANALYSIS

▲ A new industrial instrument, built for installation in one of the nation's large metallurgical plants, will be used for determining the percentages of O_2, CO_2, CO and H_2 simultaneously, and continuously recording the amounts on a single chart. The instrument is useful in processes wherever knowledge of the amounts of the gases mentioned is required. Its use enables close control in chemical processes, oil refining and in the operation of various types of kilns, inert gas producers, furnaces in the metallurgical industry and other combustion processes.

The complete analyzer operates directly from the alternating current supply line. The recorder may be located at any required distance from the sampling point and the instrument can be furnished with contacts for operating warning signals or to actuate various control circuits.

In theory the instrument accomplishes analysis by direct comparison of thermal-conductivity of the sample with that of a reference gas or by comparison of thermal-conductivity of the sample before and after chemical absorption or combustion.

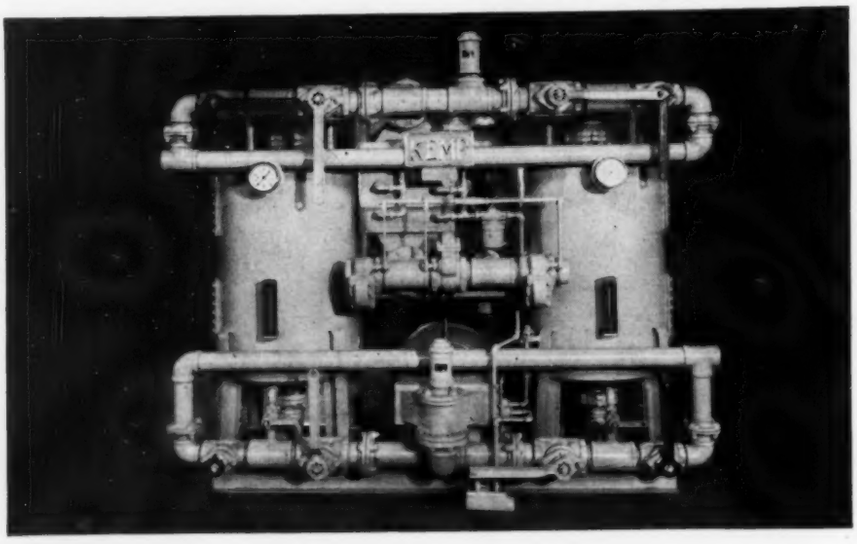
This principle of operation permits units to be assembled to meet many special problems. In the operation of a typical unit a continuous sample of the gas is drawn into the analyzer by means of a water bubbler-aspirator. The exact detail of the analysis procedure varies with the constituents of the sample but may involve a chemical absorption or combustion. The aspirator mentioned above not only draws in the sample gas but meters it, as well as the air which may be required for combustion in the analysis procedure. Chemicals, fragile glassware and moving parts in the analyzing unit have been eliminated.

In all applications the results are recorded directly without any corrections or interpolation of any kind. The upkeep required is of a routine nature and does not require the services of a technically trained man.

The recorder is automatically connected to the circuit of each analysis cell in succession, the duration of each connection being one minute. There is no additional time lag between points because the gas sample flows continuously through all cells.

A continuous record of the analysis is provided on a 10 in. strip chart, and the four different registrations (one for each gas) are shown by different colors and numbers on the chart.

The 4-point gas analyzer is a development of the Cambridge Instrument Company, Inc., 3732 Grand Central Terminal, New York City.



Whatever your drying problem . .

KEMP HAS SOLVED IT BEFORE

K. S. G. silica gel adsorptive dryers are speeding forced draft production in every war industry* that faces problems in drying gases, liquids or solids.

Kemp Silica Gel Dryers are available on prompt notice in a wide variety of standard types and sizes, while specially engineered units to meet special requirements are furnished as quickly as war conditions permit. To summarize, standard units are made in capacities from ten to 100,000 c. f. m., from atmospheric pressure to very high pressures. Activation is by gas, electricity or steam as desired, with single tower units for intermittent operation or twinned towers for continuous production.

To paraphrase a famous (and living) U. S. General, standard units may be had RIGHT NOW, special designs will take a little longer.

C. M. Kemp Mfg. Co., 405 East Oliver Street, Baltimore-2, Maryland.

***Except the dehydration of foods, which is a different problem altogether.**

KEMP of BALTIMORE

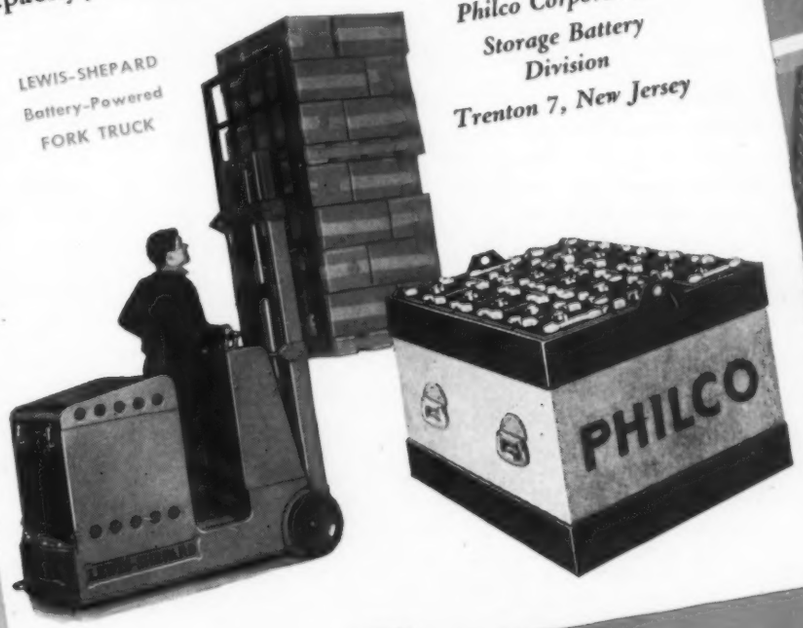
PHILCO "XL" BATTERIES

put 10% more power capacity in your present Electric Industrial Trucks!

YES, with Philco "XL" Batteries, your present electric industrial trucks will haul 10% more material! You'll get this extra work out of your materials handling equipment because Philco "XL" Batteries provide 10% extra capacity at no increase in overall battery size! Now, when you need maximum service from your trucks, find out about Philco Batteries. Drop us a note stating truck make and model. We'll tell you exactly how much more ampere-hour capacity you can get with a rugged, dependable Philco!

Philco Corporation
Storage Battery
Division
Trenton 7, New Jersey

LEWIS-SHEPARD
Battery-Powered
FORK TRUCK



Specify

PHILCO
INDUSTRIAL TRUCK BATTERIES

SHEAR CUTS 10 IN. BARS, SIX CUTS PER MINUTE

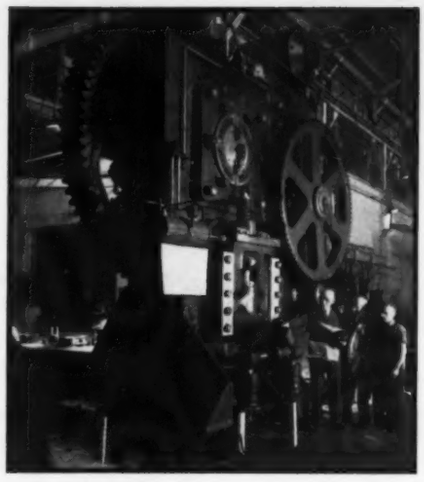
▲ Production of forged steel parts will be accelerated when the giant billet shear illustrated starts working for Timken-Detroit Axle Company at the Melvindale, Michigan plant.

Designed and built by Buffalo Forge Company, Buffalo, the No. 17 billet shear is believed to be the largest machine of its type ever constructed. Weighing over 80 tons, the machine has the well-known Buffalo electrically-welded "Armor-Plate" framel a type of construction used by Buffalo Forge Company for more than twenty-five years.

Every part of this machine is on a huge scale. Pressure on the knives is 4,500,000 pounds, making light work of cutting 10-inch steel bars at the rate of six cuts per minute. Clutch and hold-down are air operated, and automatic pressure lubrication is provided by a lubricator mounted on the machine.

The whole unit is operated by a 125 hp motor which drives the flywheel through multiple V-belts.

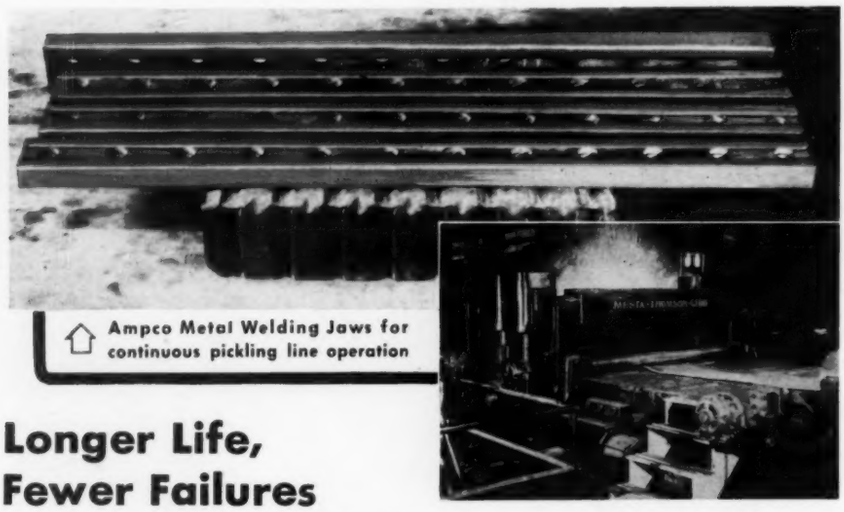
Inspecting the shear prior to demonstration to a number of industrialists last week are Gustav H. Zimmer, designing engineer, Buffalo Forge Company, Arthur Yates, superintendent of punch and shear department and Henry Lehman, foreman. These three men have a total of 26 years' service behind them at Buffalo Forge Company, all spent in building machines of this type. Their interest in this "largest of all" models is naturally keen.



INSULATING REFRACTORY OFFERED IN LARGE SIZES

▲ Announcement has been made by Johns-Manville of a new insulating Fireblok. This addition to its line of insulating refractory linings, is similar in composition and properties to the four well-known J-M insulating fire brick and is suitable for the same range of temperature conditions. But one Fireblok will cover more surface than five full sized fire brick.

The new Fireblok is manufactured in sizes — 9x 24 in., 9 x 12 in., 4½ x 24 in., 4½ x 12 in. Standard thicknesses 2½ in., 3 in. and 4½ in. (4½ in. only Jin M-1620 and JM-20). Special sizes and thicknesses are available.



Ampco Metal Welding Jaws for continuous pickling line operation

Longer Life, Fewer Failures

. . . where parts of Ampco Metal replace ordinary bronze

This alloy of the aluminum bronze class provides rare combinations of physical properties which meet the tough conditions of steel-mill operation — in screw down nuts, universal joint bearing segments, and other critical spots. These properties — in addition to good electrical conductivity and resistance to adhesion of welding spatter — also make it the ideal material for welder dies on the Mesta-Thomson-Gibb Butt Welder, where it is widely used both as original equipment and for replacements. Ampco can give equally creditable results for you. Consult your nearest Ampco Field Engineer or write for Engineering Data Sheets 38 and 73. AMPCO METAL, Inc., Dept. IS-3, Milwaukee 4, Wis.

AMPCO Reg. U. S. Pat. Off.
Metal
The Metal without an Equal

LOOKING for MORE TOUGH JOBS

On the widest range of TOUGH Rolling Mill Service, GATKE Fabric Bearings are eliminating delays and avoiding costly machine shop service. Precision moulded in all shapes and sizes for installation without machining. Made of many different material combinations to meet various service requirements in types for water lubrication, oil- or grease-lubrication and some unlubricated applications. Write for particulars.

Gatke MOULDED FABRIC Bearings

GATKE CORPORATION - 228 N. La Salle - CHICAGO

Johns-Manville points out that the new method of construction gives the Fireblok many advantages over the smaller sized fire brick units, among which may be noted:

Its large, convenient size and light weight assure fast economical installation.

It's easily cut with a saw and shaped with a rasp. Most special shapes can be either shop or field cut from standard blocks, reducing the inventory of special shapes.

The large size of Fireblok compared to the standard fire brick unit, materially reduces the number of joints, resulting in a thermally more efficient construction.

In reducing the number of joints, the Fireblok requires a minimum of mortar for bonding.

Fireblok comes in four grades — JM-1620, for exposed temperature to 1600 F, and as back-up to 2000 F — JM-20, for use up to 2000 F, exposed or back-up — JM-23, for use up to 2300 F, exposed or back-up — JM-26, for use up to 2600 F, exposed or back-up.

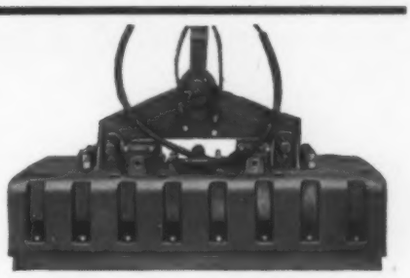
RECTANGULAR MAGNET USES CIRCULAR COILS

▲ The Electric Controller and Manufacturing Company, 2700 East 79th Street, Cleveland 4, Ohio, has announced a new line of magnets for handling billets and rails.

Type BR magnets are designed for handling either hot or cold rails or billets and may also be used for lifting bar stock, pipe, structural shapes, etc., where the service requires a heavy-duty magnet of this design and capacity. In many cases, these magnets are worked in pairs, being suspended from a spreader-bar and operated in parallel from one controller.

These magnets differ from normal rectangular magnet construction, having rectangular-shaped coils, in that coils are circular, resulting in mean-turn of short length and right-winding which gives high magnetic capacity.

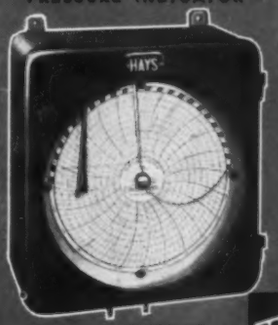
This company has issued a bulletin 901, giving complete description of these new magnets. This bulletin will be available to anyone addressing a request directly to the comany in Cleveland.



A Real Aid to PRODUCTION

TYPE CDE-X FURNACE PRESSURE CONTROLLER

SERIES FOT PRESSURE INDICATOR



SERIES OT PRESSURE RECORDER

HAYS
OPEN HEARTH
PRESSURE CONTROL

TONNAGE can be increased through more even operation and even operation also means fuel saving. Automatic control of furnace pressure, rates of fuel and air flow, ratio of fuel to air, constant volume or pressure of oil or gas relieves the operators of many time-consuming details, allowing them to pay more attention to the steel making process.

When desired, the control of these various functions can be handled manually from a centralized panel through remote operation. Hays control is all-electric, simple to install, simple to operate, simple to understand.

The following Hays instruments may be used effectively in combination or separately for the functions indicated.

Type CDE-X Furnace Pressure Controller with external manual adjustment for automatically operating stack damper to hold pressure constant.

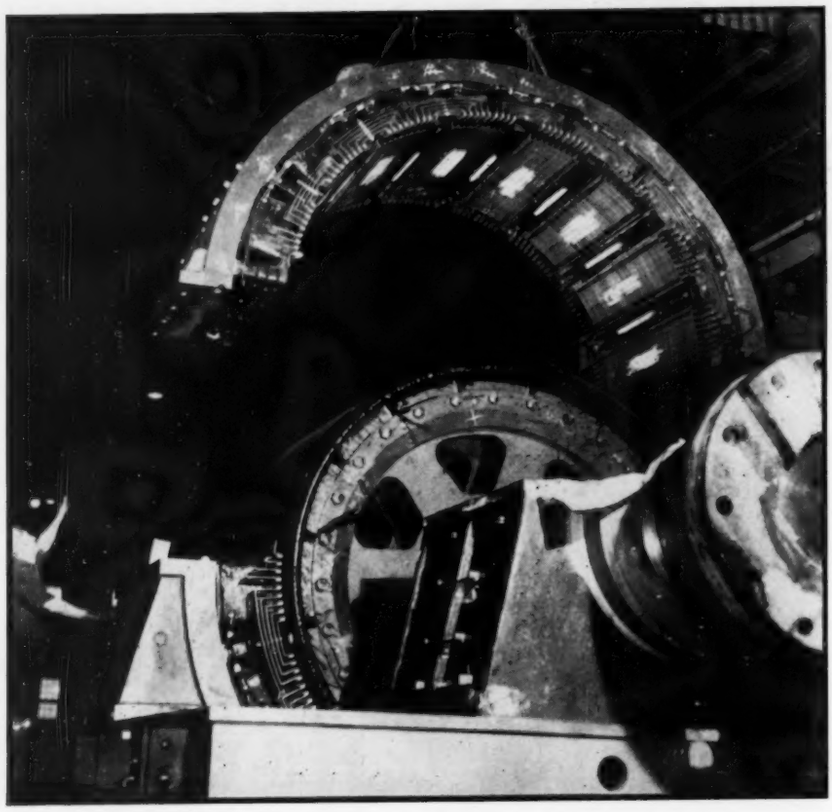
Series FOT Pressure Indicator provides an easily read measurement of furnace pressure. Usually connected at furnace roof.

Series OT Pressure Recorder provides daily record (24 hr. chart) of furnace pressure. Shows timing of reversals and each change of pressure made by operator during the heat.

Hays partial or complete instrumentation is a REAL AID TO PRODUCTION. Hays representatives located in the principal cities of the U.S.A. and Canada will gladly supply complete information.

The HAYS CORPORATION
SINCE 1901
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

EQUIPMENT FOR BRAZILIAN STEEL PLANT BEING RUSHED TO COMPLETION



The upper magnet frame of a 4000 horsepower motor leaves the test stand at General Electric's Schenectady plant for shipment to the largest steel mill in South America, now nearing completion at Volta Redonda, Brazil. A $65,000,000 project going up alongside a new city for 15,000 persons 75 miles from Rio de Janeiro, Volta Redonda will have an initial annual capacity of 350,000 tons and an ultimate capacity of 1,000,000 tons of steel ingots.

The direct-current motor will drive a mill producing structural shapes for Brazil's growing merchant marine and industries, and rails to extend railroad facilities into the interior. International G-E will also supply main drive equipments for the hot strip mill, the continuous cold mill, control equipment for various auxiliaries, numerous general-purpose motors and two 5000-kilowatt steam turbine generators for the power plant.

HYDRAULIC PRESS IN TUBULAR AXLE MANUFACTURE

▲ In the production of the recently announced, light-weight, tubular railway axles, the R. D. Wood hydraulic upsetting press plays a leading role. After one end of the seamless steel tubing is heated, it is delivered to the Wood press where, by means of external dies and an internal mandrel, the tube end is upset to the desired dimensions. This operation is then repeated for the other end.

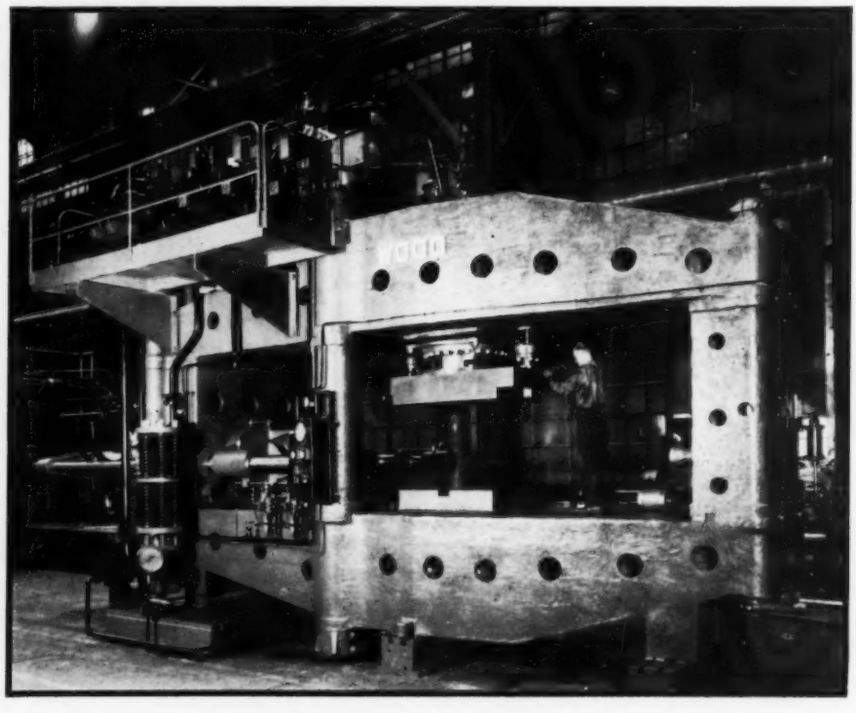
This 600/900 ton Wood press, including pump and accumulator operating system, is designed for accessibility on all sides. Note that top and bottom castings are supported against each other by distance pieces properly keyed and bolted by means of six preshrunk strain rods. The press is as accessible as the open-gap type but is far more rigid, the manufacturer points out.

The press operates on a semi-automatic cycle basis. The 28 in. diameter clamping ram, with 12 in. stroke, first clamps the tube before the guided horizontal ram can start its work stroke. When the work stroke is completed the 23 in. x 22 in. diameter horizontal ram strips from the tube before clamp ram pressure is dissipated. Vertical ram has 900 ton capacity, the upsetting ram, 600 tons. Resistance post is provided with adequate adjustment.

An air cylinder is arranged to move a space block into position, when the tube is turned around for upsetting the second end.

In order to conserve high pressure fluid, an auxiliary horizontal ram stripper is provided. This 11 in. diameter stripper acts only to strip the mandrel from the tube. A stripping force of approximately 175 tons is thus provided for a stroke of from zero to 6 in., after which the pull-back force reduces to about 32½ tons.

A reciprocating type power pump is installed which provides 3000 lb working pressure. Press, pumping and piping system are arranged as a complete recirculating unit.



New Literature

▲ Two new illustrated papers, by designing engineers, are available in bulletin form from the I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pennsylvania.

"Uses for Three-Dimension Pictorial Drawings," by J. A. C. Krips and W. S. Miller, outlines the advantages of such drawings in depicting shape and part relationship in one view, in planning manufacturing and assembly operations, and in taking the place of models. These drawings have also proved useful for determining clearances and possible interferences and in saving time in training new employees. Write for Bulletin 4311.

"Rapid-Release Latches for Circuit Breakers," by Carl Thumim, mechanical engineer, discusses the design of deadcenter and overcenter latches. The use of such latches is not confined to circuit breakers, and this publication should be valuable to designers of such equipment as automatic machinery and safety devices. Equilibrium diagrams are shown for both frictionless and frictional operation. Design hints are included for reducing strains caused by load and for eliminating the effects of impact in high-speed operation. Ask I-T-E for Bulletin 4312.

▲ "Practical Metallurgy for Engineers," fourth edition, represents a thorough, up-to-date revision of the earlier editions published between 1923 and 1929. Published by E. F. Houghton and Company, Philadelphia, Pennsylvania, the book is devoted principally to the heat treatment of steel (and some aluminum alloys) rather than to production, only 105 of the book's 479 pages dealing with the production of metals. Representing a record of the accumulated metallurgical experience of the Houghton research staff, the material includes data on recent expedients tentatively adopted during the war emergency, as well as the fundamentals and established practices.

▲ The Trumbull Electric Manufacturing Company of Plainville, Connecticut has just completed the distribution of the January 1944 issue of "Trumbullist," its general catalog.

It represents many additions, subtractions and changes in the Trumbull product.

A copy sent on request to any in the steel or allied industries.

▲ "The Practical Design of Welded Steel Structures," by H. Malcolm Priest, engineer in the Railroad Research Bureau, United States Steel Corporation subsidiaries, is a 152-page booklet published by the American Welding Society, presenting "the essentials of the design of welded steel construction with a sufficient background of collateral information that the reader may have a somewhat clearer understanding of structural welding." The book is a reprint of a paper published in the September, 1943, issue of The Welding Journal, together with additions from the paper, "Engineering Essentials for Welders," by the same author, published in the April, 1942, issue of the same journal.

▲ "Introduction to Ferrous Metallurgy" and "The Manufacture and Fabrication of Steel" are the first two books of a three-volume series prepared by E. J. Teichert, supervisor of Metallurgy Extension of The Pennsylvania State College, to provide a three-year course of training for per-

Vaportight
Industrial Lighting
CONDULETS

(CONDULETS are manufactured only by CROUSE-HINDS)

For boiler rooms, shower rooms, powerhouses tunnels, docks, building entrances, and all indoor or outdoor locations where exposed to vapors, moisture rain, smoke or non-explosive dust and gas.

Vaportight and raintight.
Wiring chamber remains vaportight even though globe is off.
Screw guard or clamp guard types.
12 Hub arrangements.
4 Reflector styles.
Accessories: colored globes, guards, half shades, adapters.
4 Sizes: 50 through 500-Watt.

Other *Vaportight* lighting fixtures are available for attachment to many round-base Condulets and sheet steel outlet boxes. Crouse-Hinds complete *Vaportight* line includes hand lamps, switches, plug receptacles, and other electrical devices.

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sons interested in the iron and steel industry. The first book covers the fundamentals essential to an understanding of the work to follow, and also includes the primary processing of iron ore in the blast furnace and the manufacture of cast iron, wrought iron and crucible steel. Methods for calculating charges and burdens for blast furnaces and cupolas are given.

The second volume deals with the bessemer, open hearth and electric steelmaking processes, as well as rolling mills, welding, forging and foundry.

As must be the case where so broad a field is covered in limited space, the subject matter is quite general, particularly in the rolling mill field. To the reader seeking a general knowledge of the iron and steel industry, however, the books should prove of considerable interest. Published by McGraw-Hill Book Company, $4.00 each.

▲ The Metallizing Company of America, pioneer manufacturers of metal spray equipment have just published a new bulletin on Mogul Flux. This revolutionary soldering compound eliminates the obvious disadvantages characteristic of many soldering compounds. The new bulletin contains valuable shop information on how to save time, money and labor, applications, directions and general information on the new Mogul Flux, including prices. Write today. Metallizing Company of America, 1330 W. Congress Street, Chicago.

▲ A four-page folder on its line of V-belts, featuring information about its recently announced wire grommet type, has just been published by The B. F. Goodrich Company and is now available upon request.

The wire grommet V-belt is an exclusive development of the company, the result of research engineering into special power problems. Twin cores of endless steel wire twisted on itself form the grummets, which are kept at a uniform distance from the sides of the belt throughout its length. The grommets are covered with counterbalancing and insulated cord.

Wire grommet V-belts are built with exceedingly high tensile strength, high resiliency to resist shock, and assure but little permanent stretch. These features, together with other advantages of grommet construction, allow a considerable increase in horsepower ratings over the conventional type V-belts.

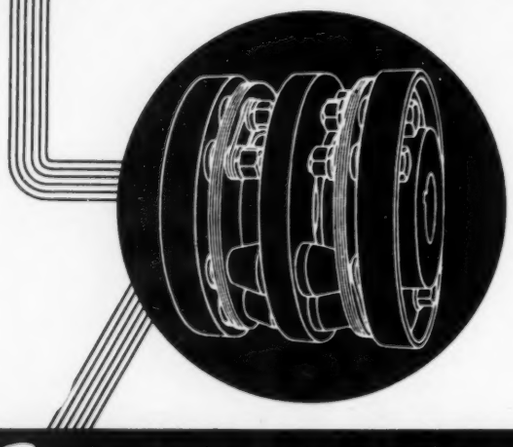
The grommet type V-belt is being furnished only on special jobs where it has been decided by belting engineers that standard belting cannot be used.

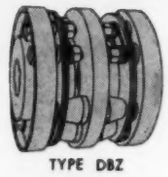
▲ The Baker industrial truck division of The Baker-Raulang Company, Cleveland 13, Ohio, has just released Baker electric truck catalog No. 52, a 20-page booklet printed in three colors.

This new catalog contains real help for any plant or warehouse faced with transportation problems. Actually, it is a handbook of information on material handling with power trucks, designed to facilitate selection of the proper equipment for any set of requirements. In addition to listing all of the standard Baker electric trucks, it illustrates many of the special models which have been designed for unusual handling operations.

Actual case histories featured throughout the book show Baker trucks of all types speeding production, saving time, money, and conserving manpower in a wide variety of installations. The reader is almost sure to find problems comparable to those in his own plant so that he can profit from the experience of others.

THOMAS
Flexible COUPLINGS

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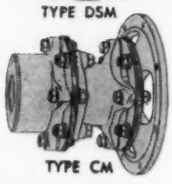
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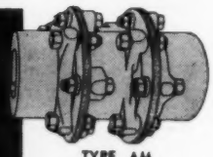
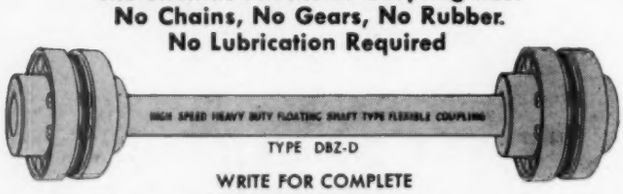

TYPE AM

TYPE-MT

Eliminate BACKLASH, FRICTION, WEAR AND CROSS-PULL
the four destructive evils of other types and makes of couplings that prevent a permanent care-free installation.

The Thomas All-Metal Coupling has:
No Chains, No Gears, No Rubber.
No Lubrication Required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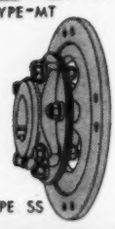
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WRITE FOR COMPLETE ENGINEERING CATALOG

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

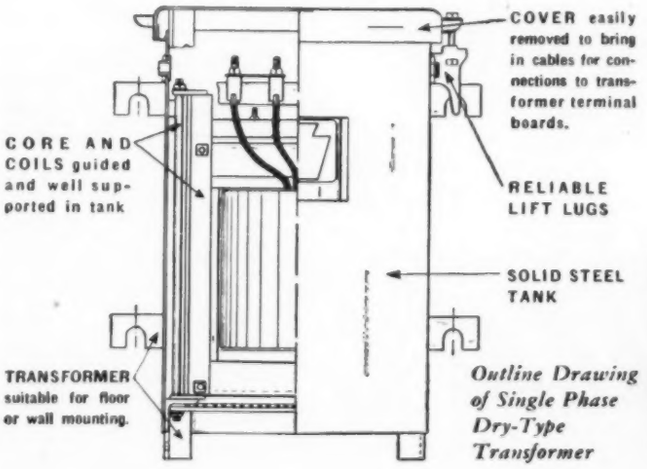
"Sure, we build DRY-TYPE TRANSFORMERS

. . . THOUSANDS OF 'EM!"

Pennsylvania TRANSFORMERS

Dry-Type Transformers are usually located indoors near the load centers where there is a great deal of work and activity. It is essential, therefore, that the live parts of the transformer be protected from bars, tools and other metal objects which are moved around the plant. Furthermore, the core and coils of the transformer must be protected from water falling on the transformer through a leaky roof or from a sweating ceiling.

These were some of the problems given careful consideration by our Engineers in designing a Dry-Type Transformer which has acquired an enviable reputation for its safe and efficient operation.


COVER easily removed to bring in cables for connections to transformer terminal boards.
CORE AND COILS guided and well supported in tank
RELIABLE LIFT LUGS
SOLID STEEL TANK
TRANSFORMER suitable for floor or wall mounting.

Outline Drawing of Single Phase Dry-Type Transformer

SAFE:

A steel plate tank completely encloses the live parts of the transformer and protects them from external injuries. Tools or metal rods carried through a plant cannot penetrate the tank and come into contact with the live parts of the transformer. This is protection for the workmen as well as for the transformer.

DRIP-PROOF CONSTRUCTION:

The transformer cover extends beyond the walls of the tank and provides a drip-proof duct around the cover for the hot air to escape. Water falling on the transformer cannot enter the tank and injure the coils.

EFFICIENT COOLING:

Cool air enters through a screen underneath the tank. The air circulates through vertical ducts in the coil, and escapes at the top of the tank, underneath the cover, thereby providing an efficient cooling system.

VERTICAL COOLING SURFACES:

All cooling surfaces in the coils are vertical. There are no horizontal surfaces to collect dust and hinder the proper cooling of the transformer.

Pennsylvania
TRANSFORMER COMPANY
PITTSBURGH, PENNSYLVANIA

HOW TO LUBRICATE ALL OF YOUR BEARINGS *At Once*

and make sure you're missing none!

Positive—inclusive—safe! With the Farval Centralized System you send oil or grease to your bearings instead of sending a man to lubricate them by hand.

Standing safely on the floor, he operates the Farval Central Pump which forces the lubricant under high pressure to all of your bearings at once.

The Farval System pays you cash dividends: Power Consumption reduced by as much as 20%—Bearing Life prolonged 5 to 25 times —Lubricant Consumption cut by 75%. Farval eliminates waste—of Time, Manpower, Materials—makes every minute count for profitable machine production.

Farval will keep *your* Cranes, Shears, Mills, Tables, Ore Bridges, Furnaces, Levellers and other equipment on the job. Send for the Farval Representative now.

The Farval Corporation, 3278 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company
In Canada: PEACOCK BROTHERS LIMITED

FARVAL

CENTRALIZED SYSTEMS OF LUBRICATION

Personnel News

Ralph B. Kraft has been appointed vice-president in charge of all sales for the Lewis Foundry and Machine Division of the Blaw-Knox Company. This appointment was effective March 1. Mr. Kraft had previously been manager of the roll sales of this company.

He attended the Lewis and Armour Institutes and had been associated with Sherwin-Williams Paint Company, and the Cleveland-Cliffs Iron Company. He also had been manufacturers' agent in Chicago for thirteen years. He joined Lewis Foundry in 1938.

L. S. Ver Bryck has been appointed New York district sales manager of the Pittsburgh Steel Company.

Mr. Ver Bryck, the Washington, D. C., sales representative since 1942, formerly was Pittsburgh district sales manager. He will be assisted by **W. J. Meyer** from the company's tubular sales order section in Pittsburgh.

W. F. Boore, acting district sales manager at New York, has been appointed assistant manager of sales, steel and oil products, at the Pittsburgh Steel Company's general office in Pittsburgh.

Joseph G. Smith, who has been acting district sales manager of the Pittsburgh district sales office, has been promoted to district sales manager for Pittsburgh Steel Company.

T. W. Rolph has been elected president of the Ohio Society of Professional Engineers.

Mr. Rolph is a member of the Illuminating Engineering Society, an associate member of the Optical Society of America, vice-president of the Holophane Company and is president of the Newark, Ohio, Rotary club.

In 1940 he was awarded a plaque by the National Association of Manufacturers, naming him a "Modern Pioneer on the Frontier of American Industry," in recognition of distinguished achievement in the field of science and invention, which advanced the American standard of living.

L. S. VER BRYCK PURDY PIX

RALPH B. KRAFT PURDY PIX

George A. Sloan of New York City has been elected a member of the finance committee of United States Steel Corporation to fill the vacancy caused by the recent death of **William J. Filbert.** Mr. Sloan has been a member of the board of directors of the corporation since January 1937.

Mr. Sloan was president of the Cotton Textile Institute from 1929 to 1935. Mr. Sloan also is president of Nutrition Foundation, Inc.

A. R. Englund, executive vice-president, was recently elected president of the Electric Service Manufacturing Company, formerly called the Electric Service Supplies Company, and **J. H. McFarlin,** electrical engineer, is now secretary.

Because of the broad scope of its activities in the research, development engineering and manufacturing of transportation, power and industrial equipment, the change in name is considered more representative of the resources and facilities of the company. Main office and plant remain in Philadelphia as heretofore, with additional manufacturing facilities in Hanover, Pennsylvania, warehouse in Chicago and branch offices in New York, Chicago, Detroit, Boston and Pittsburgh.

The change in name does not in any way affect the ownership or management of the company. Other executive positions remain unchanged.

Peter V. Martin has been appointed chief of safety for the Carnegie-Illinois Steel Corporation.

Formerly superintendent of blast furnaces at the

IMO
MOVE OIL
IMO
Serves
STEAM OR DIESEL
This De Laval-IMO fuel-oil transfer pump is installed on a Diesel-driven C-2 cargo vessel. On steamships De Laval-IMO pumps supply oil at high pressure to burners. De Laval-IMO pumps circulate "lube" oil on both motorships and steamships. IMO pumps handle any quantity of any oil against any pressure. They have only three moving parts, no valves, no gears and no cams, are free from vibration and pulsation and can be coupled directly to standard speed motors or turbines. Ask for Publication 1-110
IMO PUMP DIVISION
of the De Laval Steam Turbine Company, Trenton, N. J.

Gary Works of this U. S. Steel subsidiary, Mr. Martin began his service with the company in 1915 as a messenger in the Cincinnati sales offices. In 1920 he transferred to the South Chicago Works as a laborer in the blast furnace department and subsequently filled positions of increasing responsibility, becoming assistant division superintendent of blast furnaces in 1931.

PETER V. MARTIN

Mr. Martin was made assistant superintendent of the blast furnace and coke plant departments at the company's Gary Works in 1939 and became superintendent of blast furnaces in 1941.

He attended Massachusetts Institute of Technology and completed special courses in engineering at Northwestern University, receiving his bachelor of science degree in engineering from Illinois Institute of Technology in 1938. He is a member of the Association of Iron and Steel Engineers, American Institute of Mining and Metallurgical Engineers, American Foundrymen's Association, and the Pig Iron and Ferro Alloys Committee of the American Iron and Steel Institute.

Charles Schwarzler has been appointed manager of the export department, Foxboro Company, Foxboro, Massachusetts. He succeeds **Henry B. Moelter** who died, January 20, following a brief illness.

Mr. Schwarzler, formerly manager of the sales promotion department, is a trained engineer, with ten years of experience in the application, promotion and sale of Foxboro instruments.

R. Heath Larry has been elected secretary of the National Tube Company, U. S. Steel subsidiary, it was announced recently. He succeeds the late **E. W. Criswell.**

Mr. Larry joined National Tube in 1938 and became assistant secretary in 1940. Previously he was with the law firm of Ruslander and Kaufman.

A native of Huntingdon, Pennsylvania, Mr. Larry attended public schools at Williamsburg and Grove City. He is a graduate of Grove City College and the University of Pittsburgh Law School.

Walter S. MacNabb, who took part in the development of the world's largest steel mill, otherwise Gary Works of Carnegie-Illinois Steel Corporation, United States Steel Corporation subsidiary, has been appointed division superintendent of the plant's blast furnaces.

He has been associated with the steel industry since

1907 when he began as an apprentice in the South Chicago blast furnaces of the former Illinois Steel Company. In addition to helping in the formation of Gary Works, Mr. McNabb also spent many years in India where he assisted in the development of the Tata Iron and Steel Company plant at Jamsphedpur, major steel

WALTER S. MACNABB

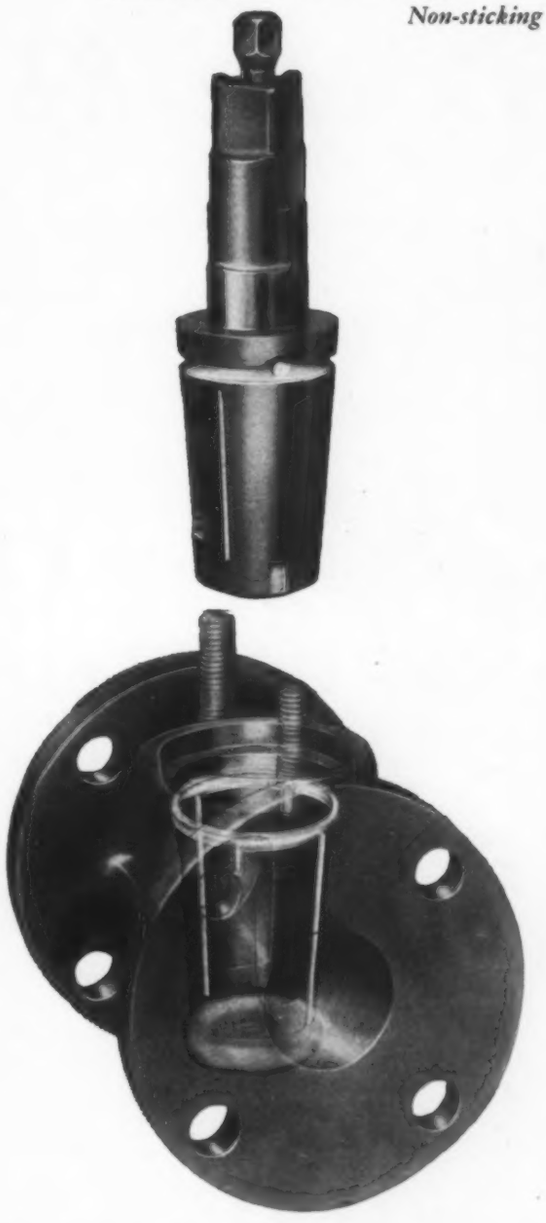
producer of the British Empire. He was superintendent of blast furnaces in the Indian plant and was closely associated with the late John Keenan, author of the recent best seller, "Steel Man in India," who was manager of the Tata plant.

Mr. MacNabb first became associated with Gary Works, May 1, 1910, and except for the years spent in India, has served continuously with the Gary organization heading various plant departments.

THE WAPAKONETA MACHINE CO.
Incorporated 1891 — Wapakoneta, Ohio.

NORDSTROM
LUBRICATED
VALVES

Simplest in design
Sealed with pressure lubricant
Non-sticking



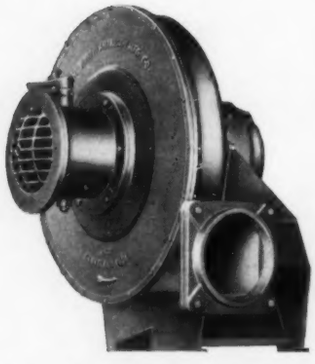
The phantom view, shown above, shows construction of the Emco-Nordstrom Valve, revealing system of lubricant channels. The plug is always seated on a film of lubricant.

Keep upkeep down
Ask for Bulletin

MERCO NORDSTROM VALVE COMPANY
A Subsidiary of Pittsburgh Equitable Meter Co.

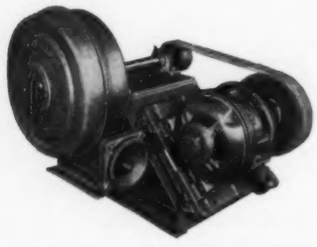
Main Offices: Pittsburgh 8, Penna. Branches: Atlanta, Boston, Buffalo, Brooklyn, Chicago, Columbia, S. C.; Houston, Kansas City, Los Angeles, New York City, San Francisco, Seattle, Tulsa.

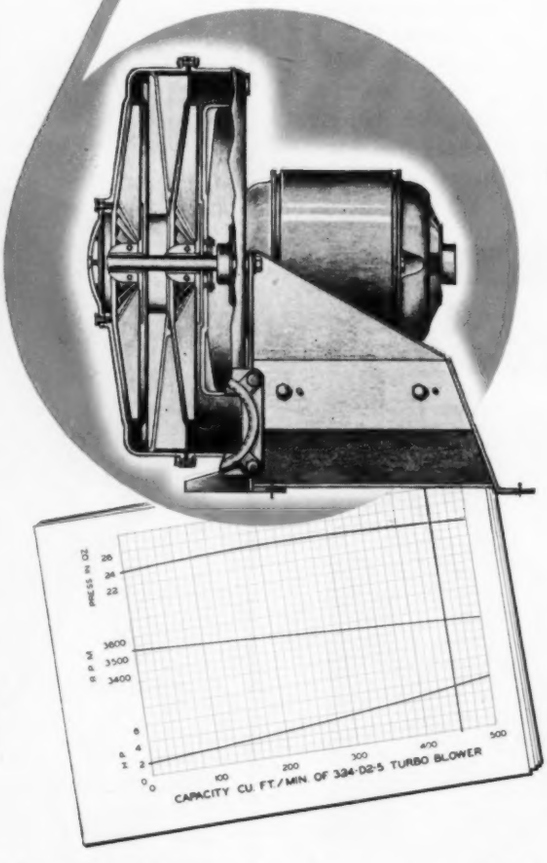
Simplicity... is the KEY NOTE in NORTH AMERICAN TURBO BLOWERS



(ABOVE) DIRECTLY CONNECTED. Butterfly valve on intake is standard equipment on larger sizes only. Smaller sizes equipped with intake guard—see section at right.

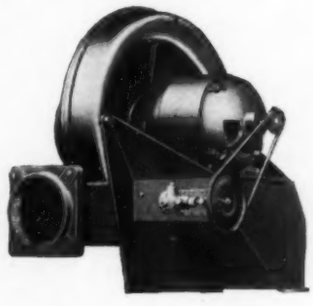
(BELOW) V-BELT DRIVEN. Used where 60 cycle A. C. current is not available.





(ABOVE) DIRECTLY COUPLED facilitates motor change. Blowers available in single or multiple stage—pressures from 8 to 32 oz. and volumes from 60 to 4300 cfm.

(BELOW) OIL PUMP ATTACHMENT for plants requiring small oil systems.



"NORTH AMERICAN for COMBUSTION"

THE NORTH AMERICAN MANUFACTURING COMPANY

MANUFACTURERS OF INDUSTRIAL FUEL BURNING EQUIPMENT FOR GAS OR OIL

BRANCH OFFICES *with* FIELD ENGINEERS *in* PRINCIPAL CITIES

CLEVELAND, OHIO

Alex Montgomery, Jr. has been appointed assistant general superintendent of the Duquesne Works, Carnegie-Illinois Steel Corporation. **Walter A. Jayme** was made assistant general superintendent in charge of special quality steels at this U. S. Steel subsidiary plant.

Mr. Montgomery has been with Carnegie-Illinois since 1935, and came to this company from the American Bridge Company plant at Ambridge, Pennsylvania. Prior to his recent appointment he served as superintendent of rolling at the Duquesne plant. He was graduated from the University of Kentucky 1928 with a bachelor of science degree in civil engineering.

Mr. Jayme began his service with the company in 1935 as contact man in the metallurgical division, Pittsburgh general office. In 1936 he became manager of the alloy division, and a year later was appointed superintendent of the company's Wood Works in McKeesport, Pennsylvania. He was transferred to Duquesne Works in 1940. Mr. Jayme graduated from the Massachusetts Institute of Technology in 1921 and holds a degree in mining engineering.

William D. Turnbull, who has been vice-president and sales manager of the Pomona Pump Company of California, has been appointed manager of the Westinghouse Electric and Manufacturing Company's agency and specialties department.

Mr. Turnbull's appointment marks his return to Westinghouse after an absence of four years. He first joined the Westinghouse staff in 1923, the year he was graduated from the Pennsylvania State College, and became affiliated with the company's sales division soon after completing a graduate students' course. For many years he was associated with metal working, machinery and mine electrification sections of the Westinghouse sales department. Before joining the Pomona Pump Company in February, 1940, he was manager of the Westinghouse machinery electrification section.

Frank J. Hirner has been appointed manager of the St. Louis district of the Harnischfeger Corporation, Milwaukee, with offices at 4030 Chouteau Avenue, in that city. Mr. Hirner will be in full charge of sales and service in the area for the comprehensive P&H lines of electric overhead traveling cranes and hoists, a-c and d-c welders and welding electrodes, welding positioners, and gasoline, diesel, and electric-powered shovels, crawler cranes, draglines, clamshells, etc. He is a mechanical engineer.

J. D. Glatz has been named manager of the repair sales division of the Harnischfeger Corporation, Milwaukee.

He recently returned from Washington after two years with the WPB as chief of the crane and hoist section in the tools division. Prior to that, he was representative for P&H in the Chicago area.

Lyman D. Warner has been appointed sales manager of the Crocker-Wheeler Division, Joshua Hendy Iron Works, Ampere, New Jersey.

Mr. Warner is well qualified for the new position, having been assistant sales manager since 1941 and active in the sale of motors, generators and flexible couplings for Crocker-Wheeler since 1937.

Prior to his connection with Crocker-Wheeler he was associated with the Ingersoll Rand Company and the

ALEX MONTGOMERY, JR. PURDY PIX

General Electric Company in Schenectady, New York and Chicago. He is a graduate of Lehigh University, where he received the degree of electrical engineer in 1928.

T. C. Knudsen has been named manager and chief engineer of the new Texrope department established by Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin. The new department, which will handle the Texrope line of multiple V-belts and sheaves, was established as part of a reorganization move, in which Allis-Chalmers set up a separate basic industries department.

Mr. Knudsen has been closely associated with the Texrope drive from its inception and played a major part in its development. He entered the employ of Allis-Chalmers in 1922, as a member of the milling machinery department.

J. F. Joyce has been appointed Cleveland district sales representative for the Pennsylvania Transformer Company. J. J. Costello Company has been named sales representatives to handle the company's affairs in New England territory, with offices in Boston, Massachusetts, and New Haven, Connecticut.

Robert Arnold Sales and Engineering Company, Otis Building, Philadelphia, has been appointed to represent the C. M. Kemp Manufacturing Company, Baltimore, in the Philadelphia area.

William Isaacs has retired as superintendent of the masonry department, Youngstown Sheet and Tube Company, Youngstown, Ohio, after 40 years with the company.

WITH MATTHEWS

Champion Holder

"Champion" Steel Type Holders are recommended for 90% of all heavy and medium duty marking, which requires long, continuous hard usage. Made for hand or press stamping of all types of industrial products, with interchangeable letters, figures or symbols.

Write for Catalog 146-A

JAS. H. MATTHEWS & CO.

3982 Forbes Street Pittsburgh 13 Pa.

Branch Plants

New York, Boston, Chicago, Philadelphia, Newark, Syracuse

District Sales Offices

Cleveland Detroit Hartford Birmingham

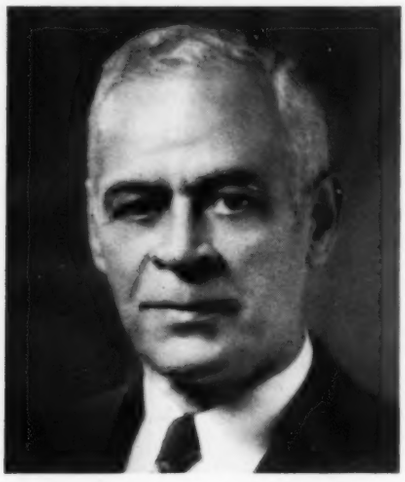
Specialists for over a generation in

OIL IMMERSED MOTOR CONTROL

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

W. R. Kottsieper has been appointed manager of the valve department, American Car and Foundry Company, with offices at 30 Church Street, New York City. Since 1929 Mr. Kottsieper has been active as assistant manager in promoting the sale of the ACF lubricated valve.



W. R. KOTTSIEPER

H. P. Ackerman has been named assistant manager in charge of sales promotion and development of new types of valves, as well as new products that can be manufactured by the valve division. Mr. Ackerman has been a valve salesman since 1923, and has spent the past ten years with the American Car and Foundry Company as sales engineer specializing on Navy applications and Maritime Commission valves for ships. He is a member of the Association of Iron and Steel Engineers.

H. P. ACKERMAN

George D. Sells, formerly associated with American Steel and Wire Company, Duluth, has been appointed superintendent of blast furnaces for Pittsburgh Steel Company, Pittsburgh, and **Charles D. Steele** has been named assistant superintendent of blast furnaces. Mr. Steele has been associated with the company for a number of years as blast furnace foreman.

H. P. Munger, formerly superintendent of Republic Steel Corporation's electrotinning plant at Niles, Ohio, has been appointed plant manager at Olean, New York, for two of the plants of Van der Horst Corporation of America, Cleveland.

H. P. MUNGER

W. H. Feldmann, vice-president and general manager since 1940, has been elected president and general manager of Electric Machinery Manufacturing Company, Minneapolis, Minnesota.

W. H. FELDMAN

Mr. Feldmann has been associated with the company for 22 years, having been in charge of district sales at Cleveland and Chicago before his appointment as general sales manager in 1927. In 1936, he was elected a director of the company, and in 1937 made vice-president in charge of sales.

Silas McClure, president since 1921, was elected to the chairmanship of the board of directors, Electric Machinery Manufacturing Company.

Prolong Life of Ball and Roller Bearings

Those you lose from faulty lubrication will be very hard to replace. Defense needs are resulting in a shortage of wanted sizes. Why take chances with bearings of machines vital to production?

NON-FLUID OIL safeguards bearing life by lubricating dependably. It protects bearings from pitting and corrosion, so guarantees long life and trouble-free operation. Recommendation by leading makers of ball and roller bearings proves it superior to grease.

Used successfully in leading iron and steel mills. Send for instructive bulletins.

•

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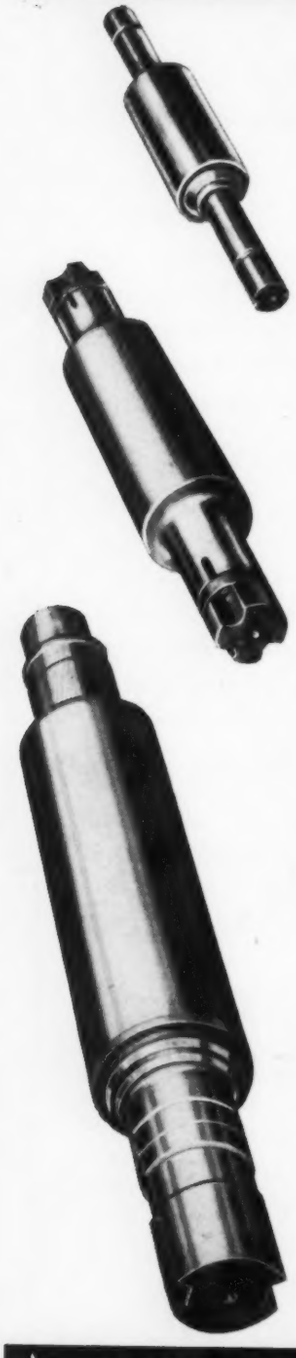
TRADE MARK REGISTERED
NON-FLUID OIL
IN U.S. PAT. OFFICE & FOREIGN COUNTRIES

Modern Steel Mill Lubricant

Better Lubrication at Less Cost per Month

NATIONAL ROLLS



Better Rolls
From All Makers

IMPROVEMENTS in making rolls, promptly passed on, benefit not only the entire roll-making industry but the steel industry as well.

Selfishness or secrecy have no place in this highly exclusive Guild.

It is too important that ALL rolls may endure. Faulty implements not only blemish the maker but affect the confidence of the steel industry at large. So rolls must hold the pace and this demands free exchange of ideas.

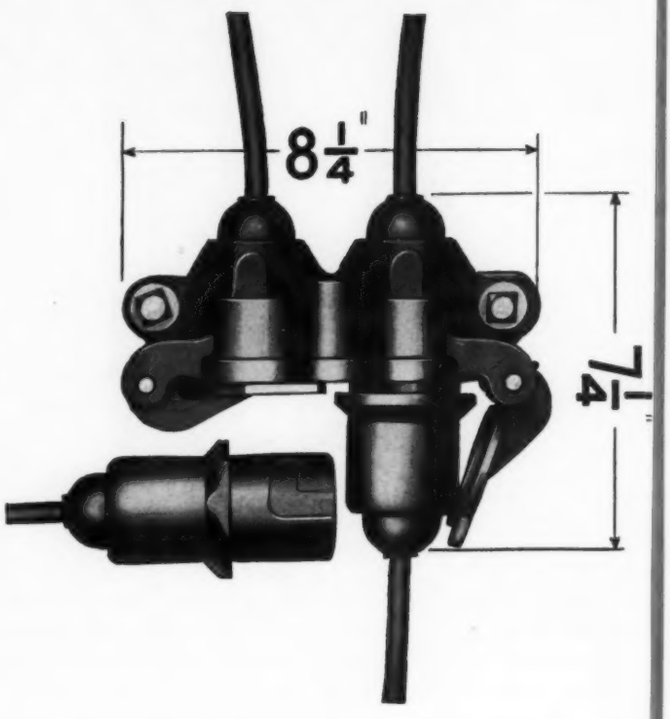
NATIONAL ROLLS are abreast of the advance of the industry. They incorporate the best practice in every step of their making, and may be relied upon to deliver reasonable tonnage of a highly uniform quality.

The NATIONAL ROLL & FOUNDRY COMPANY

All Grades of Cast Rolls—Iron and Iron Alloy—Steel and Steel Alloy
Heavy Iron Castings and Rolling Mill Equipment

AVONMORE, PA.

OHIO ARMORED WEATHER PROOF CONNECTORS



Save time to make or break connections.

They are operated by hand, (see the Bayonet Joint in Cut).

No Tools or Tape required.

No danger, live parts covered by insulated Iron Shell.

Two Pole Connectors have Automatic Spring Cover closing live end when not connected.

They also have support Ears for mounting (see cut).

Single Pole Connectors are furnished without Spring Closing Covers or Support Ears.

Cable Ends are No. 4 B & S Extra Flexible Insulated Wire.

Capacity 150 amperes continuous.

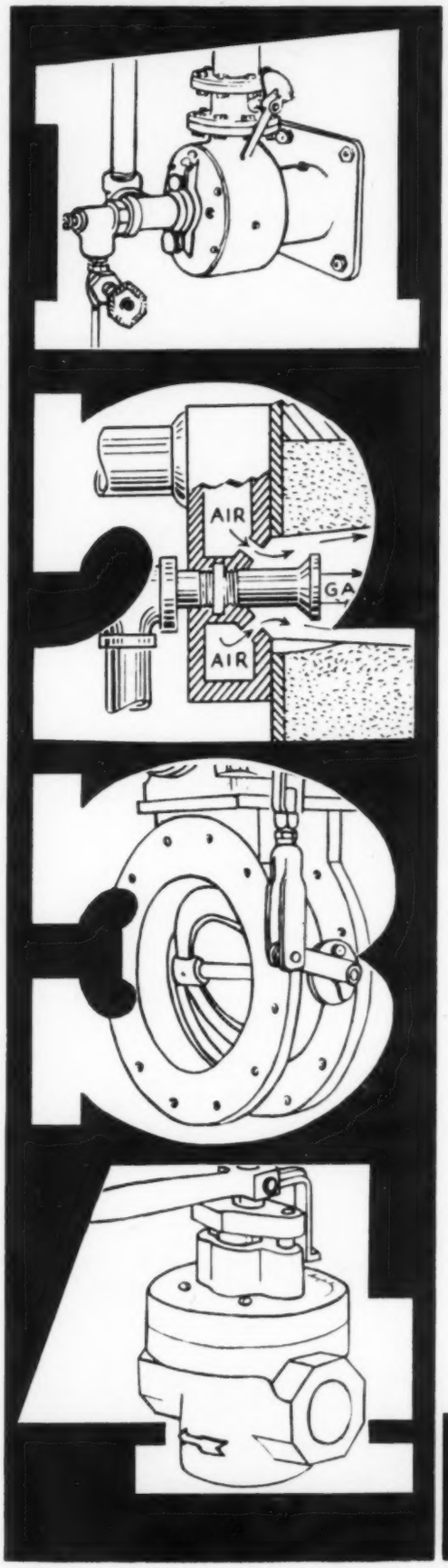
	Weight	Net Price
Single Pole Connectors	5 Lbs.	$12.00 Each
Double Pole Connectors	13½ Lbs.	$25.00 Each
Lower or Plug End Separately		$ 7.50 Each

Priority required — F. O. B. CLEVELAND

OHIO reliable MAGNETS

The OHIO Electric Mfg. Company
5907 Maurice Avenue
Cleveland 4 · · Ohio

FOUR BLOOM "Firsts"



ENGINEERED TO SIMPLIFY YOUR INDUSTRIAL COMBUSTION PROBLEMS

LONG FLAME BURNER

Provides quick change from gas to oil or oil to gas without sacrificing uniform heating conditions, and with less consumption of fuel. No shutdown or delay. Over 7500 satisfactory installations.

TEMPERED FLAME COMBUSTION

Provides controlled uniform heating and flexibility for high and low temperature cycles—will stay lighted with 1000% excess air. Particularly valuable where furnace load fluctuates over wide range.

BLOOM REDUCED PORT BUTTERFLY CONTROL VALVES

Manual, motor or hydraulic operation. Port sizes to suit flow needs. Non-sticking valve plates. Lubricated shaft bearings. Close machining suitable for 40 to 1 turndown.

CALIBRATED-FLOW OIL VALVES

Provide accurate and uniform control of heavy liquids such as tar or heavy oil. Manual or motor operated—only one moving part.

Bloom engineers are available anywhere, anytime for consultation on combustion problems.

BLOOM ENGINEERING COMPANY

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DESIGNED and BUILT for THE JOB

P-G Steel Grid Resistors

★ ALL STEEL CONSTRUCTION
★ MICA INSULATION
★ RUGGED TERMINALS
★ PROVISION FOR EXPANSION
★ ADEQUATE VENTILATION
★ UNAFFECTED BY VIBRATION
★ MOISTURE RESISTANT
★ CORROSION PROTECTED

FOR STEEL MILL SERVICE..

WRITE FOR
BULLETIN No. 500

On cranes of all types, ore bridges, ore unloaders, charging machines, mill tables and many other kinds of mill controls where service conditions are severe. Continuous trouble-free service is assured with P-G. . . .

P-G

"The Resistor you can Install and Forget"

THE POST-GLOVER ELECTRIC COMPANY
• ESTABLISHED 1892 •
221 WEST THIRD STREET, CINCINNATI, OHIO

...with ASKANIA

1+P=9

A CONTROL FORMULA WHICH HAS PROVED ITSELF

Again and Again

It's simple, the way this formula works . . . 1, is for installation . . . P, is for performance . . . and 9, is for the total installations of one company! For instance Company A proved it in this fashion . . . In June 1939 Askania Automatic Control was installed on the first of a series of open hearth furnaces, that was # 1.

Performance records carefully kept by Company A emphatically indicated the advisability of equipping a second open hearth installation with Askania Automatic Control. In rapid succession a total of 9 furnaces were equipped with Askania Control.

While exact figures are not released for publication, Company A is emphatically convinced that Askania Control is responsible for:

Longer Campaigns Per Furnace

Increased Tonnage at Lower Fuel Cost

Complete details and further evidence are yours for the asking. Simply request bulletin 115.

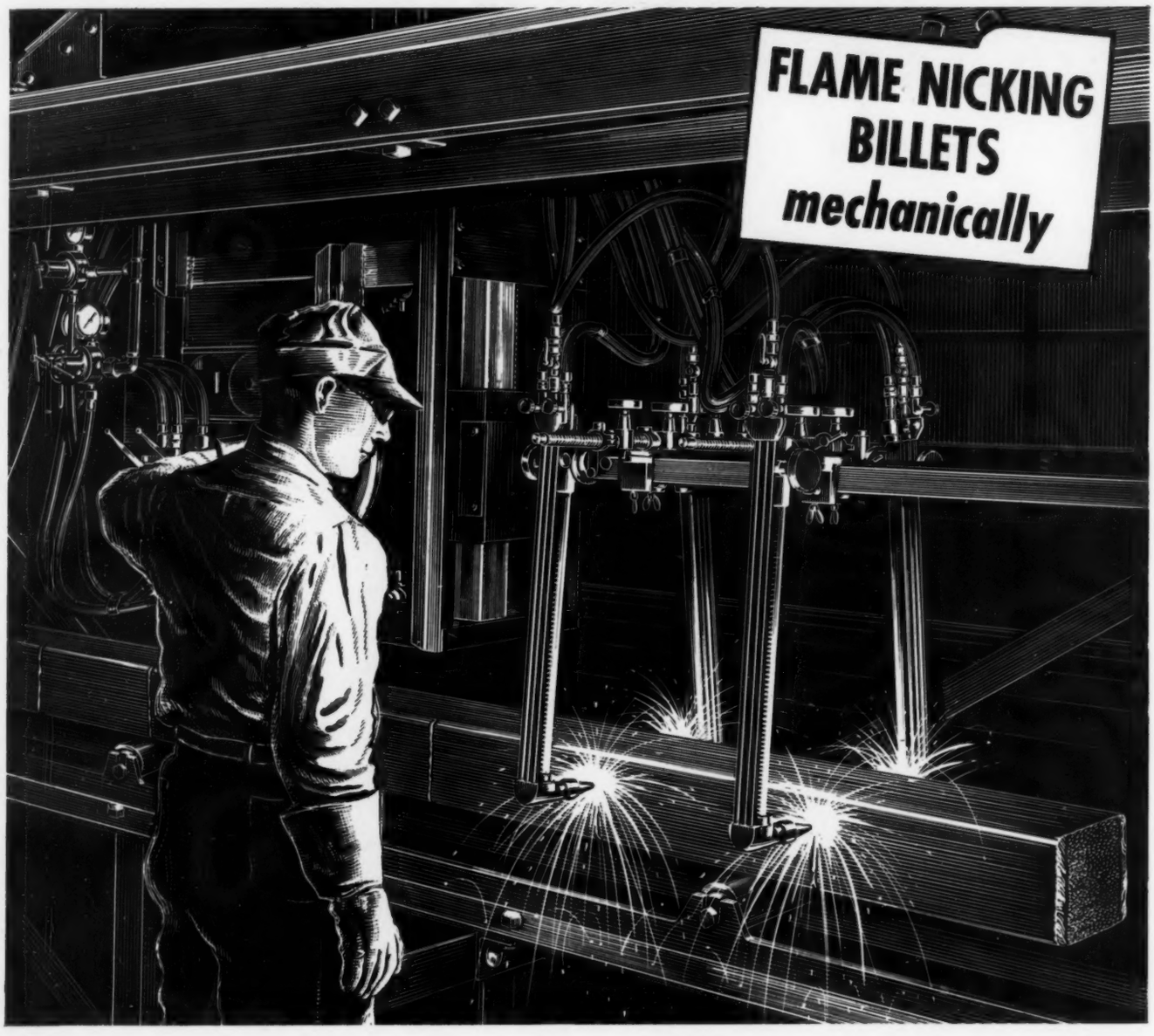
JET PIPE PRINCIPLE

ARMY E NAVY

ASKANIA REGULATOR CO.

1603 S. MICHIGAN AVENUE, CHICAGO

A TYPICAL CASE *from Airco's Research and Service files*



Because of Air Reduction's extensive experience in applying flame cutting methods to many varied industrial jobs, its Research Engineers were able to meet this customer's needs in fast time. By pooling their specialized "know how" with that of the customer's production staff, they soon designed and built the multiple torch billet nicking machine shown above, vitally needed for the production of shells.

This "tailor-made" machine employs four cutting torches to make simultaneous cuts a fraction of an inch into both sides of a billet, at speeds of from 20" to 30" a minute. After nicking, the blanks are cleanly separated by a hammer blow.

Later on, as shell production schedules rose, this same machine was redesigned to employ eight cutting torches, which nick the billets only on one side, thus providing an even faster mechanical procedure.

This actual case serves to illustrate Air Reduction's established policy of providing helpful engineering service to meet customers' special needs. This service is an integral part of Airco's *complete* oxygen service to industry. Airco products for every flame and arc application—and engineering service to promote their efficient use—are available through Air Reduction's nationwide plants and offices.

★ BUY UNITED STATES WAR BONDS ★

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DEADENDING

Heavy Feeder Cables

HERE'S a Keystone "hard-to-beat" combination for deadending heavy cables. Long clamping surface provides positive grip on conductor. Note clamp is round and of small diameter to facilitate taping and is free of sharp projections which might pierce tape insulation. In combination with the Keystone Giant Strain Insulator which is porcelain covered for all weather service and backed by over 30 years of unfailing service you have a "hard-to-beat" combination. You can do a better, longer-lasting job with Keystone.

Ask for Catalog

Manufactured by **ELECTRIC SERVICE SUPPLIES COMPANY**

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HEADQUARTERS FOR TRAVELING ELECTRICAL CONTACT AND HEAVY FEEDER SYSTEM MATERIALS

EQUIPMENT
FOR EVERY MODERN STEEL MILL JOB!

...BUILT by BIRDSBORO

• Birdsboro builds a complete line of equipment for the modern steel mill. Auxiliaries, such as the Birdsboro universal hot bed shown here, are important "assistants" in getting maximum production from your steel mill operations.

Into each piece of Birdsboro equipment goes the engineering skill of Birdsboro specialists who have spent the greater part of their life in building better steel mill equipment for American industry.

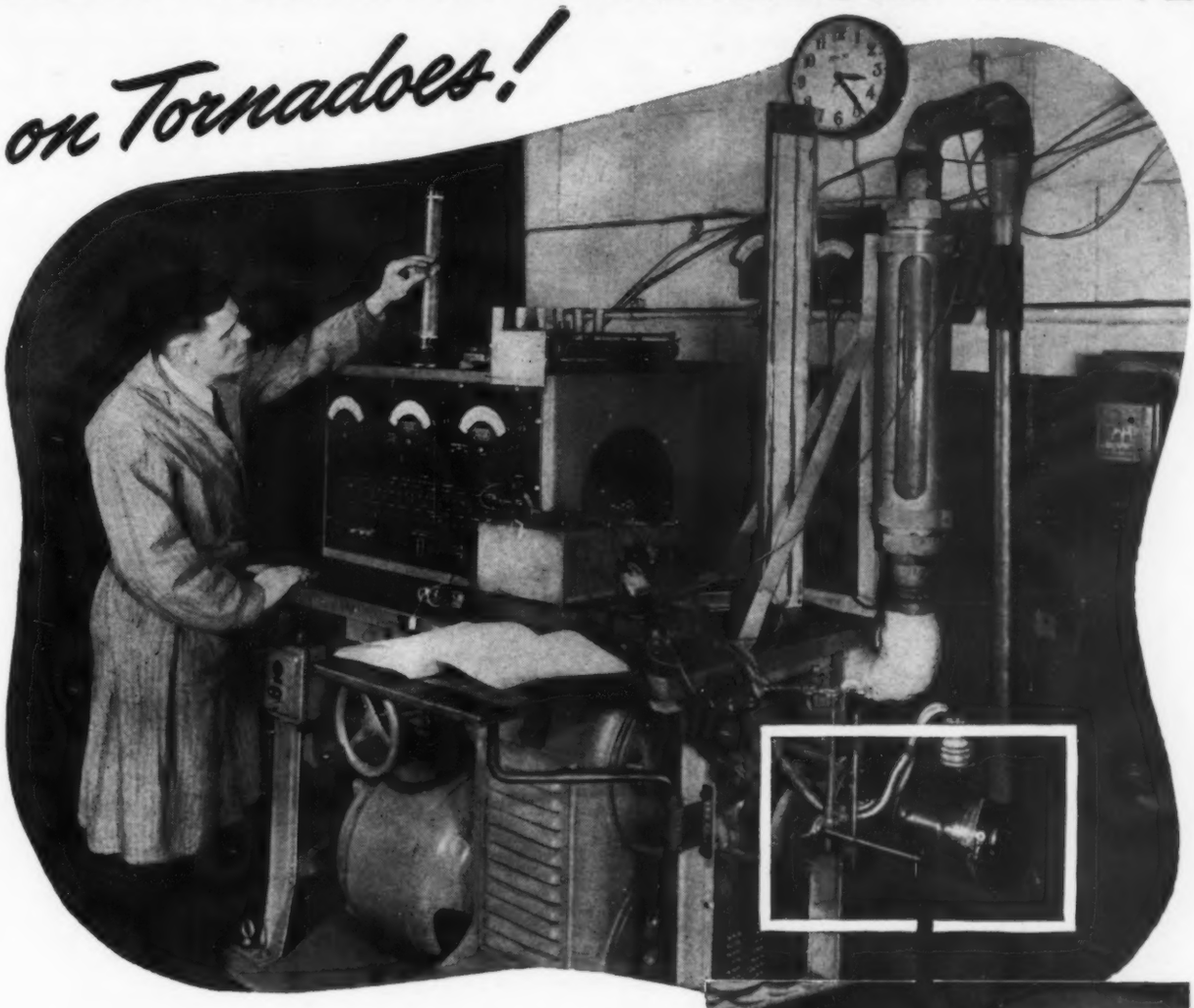
If you are considering installing any type of steel mill equipment, it will pay you to enlist the services of Birdsboro engineers. They will be glad to work with you on your individual problems.

BIRDSBORO

STEEL MILL EQUIPMENT

MAKING AIRPLANE GENERATORS THRIVE

...on Tornadoes!



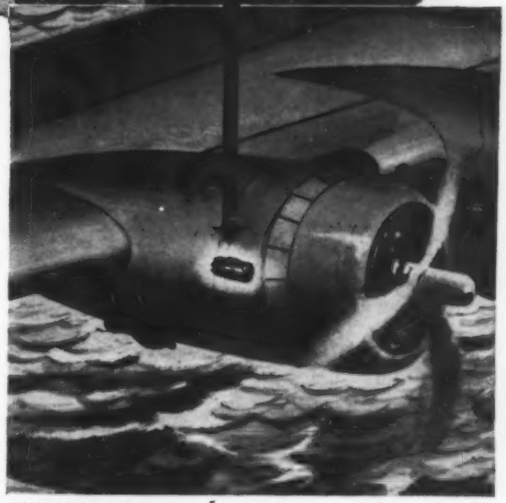
One reason why National Carbon research develops brushes that meet severest operating conditions:

THE BRUSHES that can take the punishment . . . at the highest altitudes of modern aerial warfare . . . passed their *low-altitude* tests on the stand shown above. This stand forces a veritable tornado of *accurately metered* air through a heavy-bomber generator working at rated capacity, measuring brush and generator operation under perfectly reproduced sea-level flight conditions.

The perfection of new high-altitude brushes again proves the ability of National Carbon Company's Research Laboratories staff to develop brushes of all types and for all duties . . . from locomotive motors and giant turbo-electric generators, to small, fractional horsepower units.

Research, experience, and cooperation in solving customers' problems have given "National" brushes undisputed leadership . . . have made them available in the proper grade for every application.

We invite you to bring your brush problems to us. If you have not received copies of "Modern Pyramids"—on brush principles and care—write National Carbon Company, Inc., Cleveland 1, Ohio, Dept. 20c



THE GENERATOR shown here weighs only 42 pounds, yet develops 200 amperes at 30 volts . . . rating contingent on air-blast cooling.

★ *BUY UNITED STATES WAR BONDS* ★

The word "National" is a registered trade-mark of National Carbon Company, Inc.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

CARBON PRODUCTS DIVISION, CLEVELAND 1, OHIO UCC New York, Pittsburgh, Chicago, San Francisco

CONTRACT PIPE CLEANING

ENGINEERING AND OPERATING SERVICE

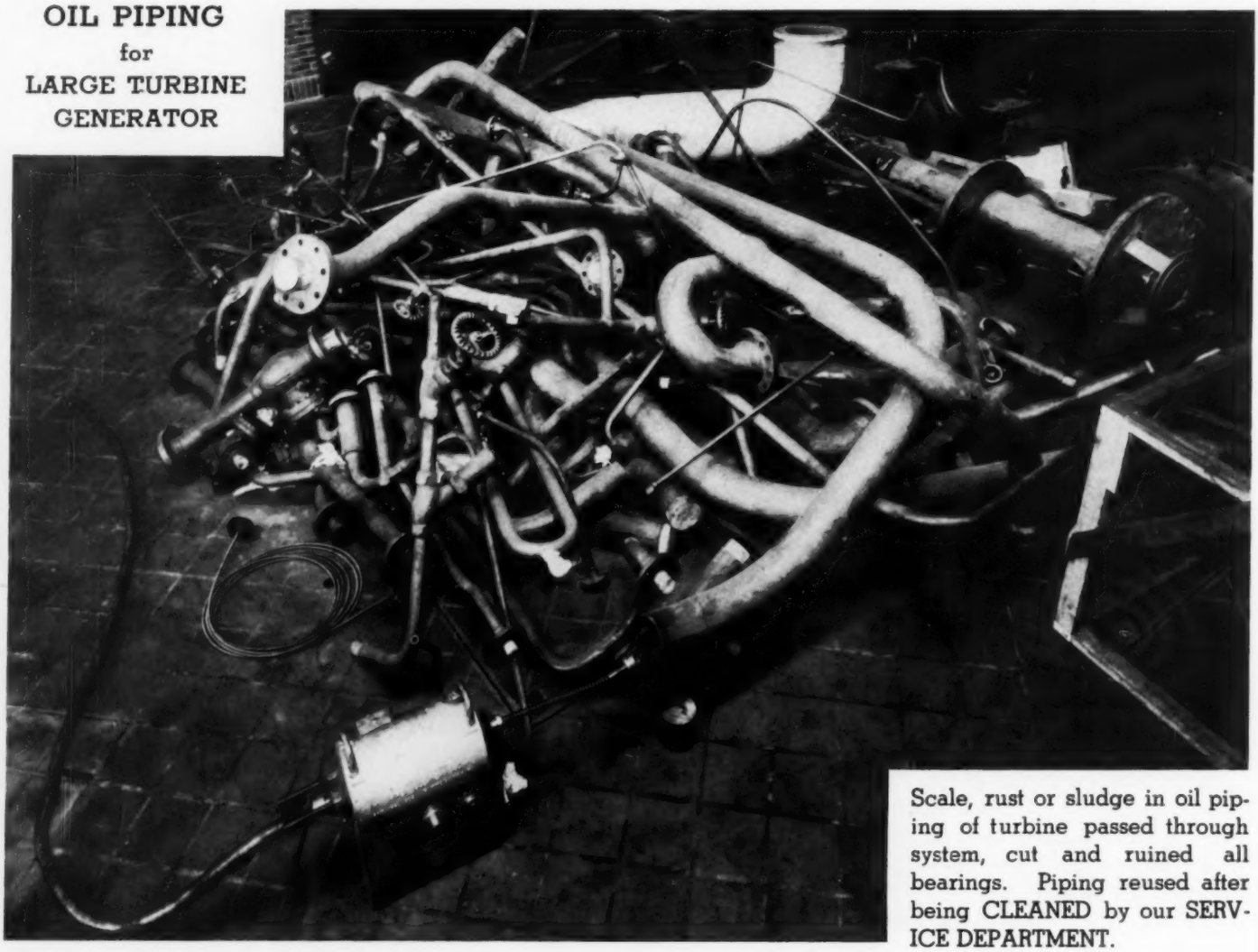
FOR

WATER - GAS MAINS - SEWERS

AND

ALL TYPES AND SIZES OF PIPE CONSTRUCTION

OIL PIPING
for
LARGE TURBINE
GENERATOR



Scale, rust or sludge in oil piping of turbine passed through system, cut and ruined all bearings. Piping reused after being CLEANED by our SERVICE DEPARTMENT.

PITTSBURGH PIPE CLEANER COMPANY

PITTSBURGH, PA.

New York - Philadelphia - Washington - Baltimore - Chicago - St. Louis - Detroit

Plan for Today and Tomorrow

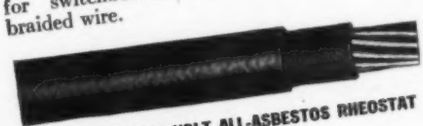
INSTALL ROCKBESTOS A.V.C.

IN CIRCUITS EXPOSED TO SEVERE OPERATING CONDITIONS

ROCKBESTOS A.V.C. 600 VOLT BOILER ROOM WIRE
(Underwriters' Type AVA)

Sizes No. 18 to 4/0 AWG. This construction for sizes 18 to 8, sizes 6 to 4/0 have another wall of felted asbestos next to the conductor.

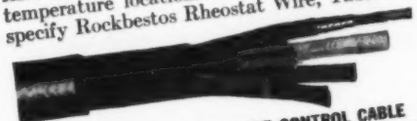
For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A.V.C. construction is ideal. Also for locomotive panel wiring and for switchboards requiring an asbestos braided wire.



ROCKBESTOS 600 VOLT ALL-ASBESTOS RHEOSTAT CABLE
(Underwriters' Type AI)

Sizes No. 18 AWG to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For solid conductor specify Rockbestos Rheostat Wire, Table A.



ROCKBESTOS A.V.C. 600 VOLT CONTROL CABLE

In one to 19 conductors. Standard stranding AWG No. 12—19/No. 25 and No. 9—19/No. 22. Other strandings furnished.

Designed for use under conditions too severe for control cables with other types of insulation which deteriorate rapidly when exposed to high temperatures. Operates without failure under the attack of heat, oil, grease or corrosive fumes and may be installed in conduit as it has ample moisture resistance.

Rockbestos A.V.C. 600 Volt Power Cable, illustrated*, No. 18 AWG to 1000 MCM, Underwriters' and N.E. Code, Type AVA, Maximum operating temperature 110°C., has this permanently insulated construction. (Also, with lead sheath and in voltage ratings up to 5000.)

WHY PERMANENTLY INSULATED ROCKBESTOS A.V.C. WILL GIVE YOU DURATION-PLUS SERVICE*

1. The conductor is perfectly and permanently centered in helically applied insulation.
2. Impregnated asbestos insulation withstands the heat of overloads up to the melting point of copper and won't ignite or burn.
3. Lubricated varnished cambric for high dielectric strength and added moisture resistance, protected from heat and flame by two impregnated asbestos walls.
4. Outer impregnated asbestos wall which serves as a heat-barrier against high ambient temperatures.
5. A tough, rugged, impregnated asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.

**One of 122 different wires and cables developed for severe operating conditions by Rockbestos.*

Won't bake brittle, burn, flow or rot.
Resists moisture, oil, grease and fumes

In wartime, you want wires and cables in circuits that run around furnaces, lehrs, boilers, steam tunnels, etc. that give trouble-free service no matter how severe the operating conditions. And not only do you want them to give duration service but also freedom from wire-failures for years to come.

Rockbestos A.V.C. *permanently insulated* wires will give you just that kind of performance. Because the *permanent* impregnated asbestos insulation is highly resistant to heat, flame, moisture, oil, grease and alkalies, it won't bake brittle, crack, bloom, rot, flow or swell under the severest conditions. When installing new circuits, or rewiring old, plan for both today and tomorrow—install Rockbestos A.V.C. in all circuits exposed to wire-destroying conditions.

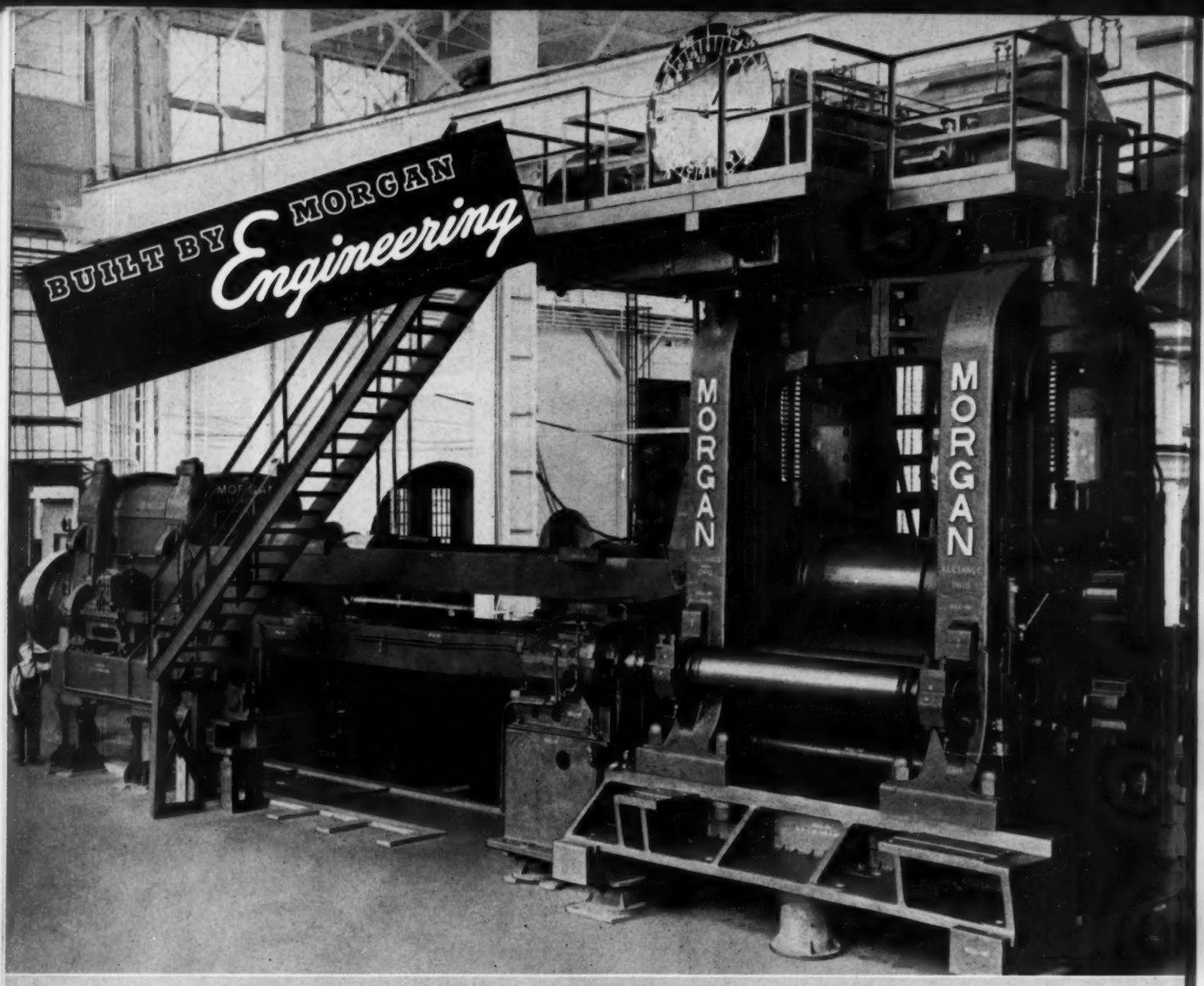
When inquiring or ordering, please furnish CMP allotment number or symbol with proper certification. For samples and literature write nearest branch office or:

Rockbestos Products Corp., 933 Nicoll Street, New Haven 4, Conn.

For Victory
Invest in U. S. War Bonds

ROCKBESTOS A.V.C.
The Wire with Permanent Insulation

NEW YORK, BUFFALO, CLEVELAND, CHICAGO, PITTSBURGH, ST. LOUIS, LOS ANGELES, SAN FRANCISCO, SEATTLE, PORTLAND, ORE.



MORGAN "36" TWO-HIGH BLOOMING MILL

Above is shown a Morgan 36" Two-High Blooming Mill on erecting floor. Housings are one piece steel castings of the closed top type. Top roll balance is of the counterweight type. Top roll lift sufficient for rolling 42" wide slabs. Manipulator is of the overhead type, compact and accessible. Tables are of heavy design, equipped with anti-friction bearings.

With this Mill was furnished Auxiliary Equipment as follows — Front and Rear Tables with Manipulator — Approach Table — Ingot Buggy — Runout Tables — Slab Shear with Gauge — Crop Hoist — Pushers — Conveyor — Skid Bed and Furnace Tables.

THE MORGAN ENGINEERING CO.

ALLIANCE, OHIO. 1420 Oliver Building, Pittsburgh

DESIGNERS • MANUFACTURERS • CONTRACTORS • BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS • ELECTRIC TRAVELING CRANES • CHARGING MACHINES • INGOT STRIPPING MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEAM HAMMERS • STEAM HYDRAULIC FORGING PRESSES • SPECIAL MACHINERY FOR STEEL MILLS

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for MAXIMUM CAPACITY IN MINIMUM SPACE

Interchangeable

WITH SINGLE-ROW BALL BEARINGS

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PRECISION ROLLER BEARINGS

NORMA-HOFFMANN BEARINGS CORP'N.,

STAMFORD, CONN., U. S. A. • *Founded in 1911.*

Write for the Catalog. Let our engineers work with you.

Their solid cylindrical rollers provide maximum contact area, giving larger load and shock-absorbing capacity than any other single-row bearing of like dimensions. Thus, when NORMA-HOFFMANN PRECISION ROLLER BEARINGS are used in place of ball bearings, a greater factor of safety is provided, together with added life, particularly under vibration and overload. PRECISION qualities in workmanship and materials adapt them alike for both low and high speeds.

All for Steel Mills...

ALL BY I-T-E

KC CIRCUIT BREAKERS

TOMATIC RECLOSING IRCUIT BREAKERS

FB CIRCUIT BREAKERS

For protection and control of electrical systems, steel mills present such a variety of conditions that only from a variety of equipments can proper choice be made. That is why I-T-E in emphasizing one type of equipment surrounds it with identification of other types, each of which has its place in the modern mill.

In offering variety, I-T-E offers with it full information as an aid in making a choice. Catalogs? Yes, but more than that—the time of engineers who know steel-mill conditions so well that they expect to work on yours as a problem in itself needing study of its own.

B CIRCUIT BREAKERS

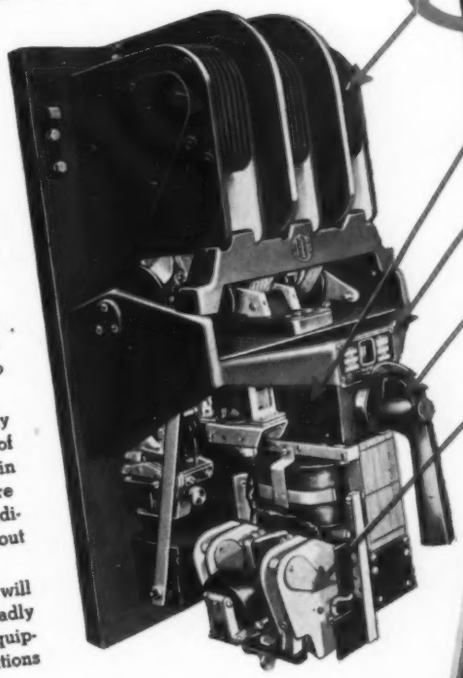
pe KB circuit breakers are used for protection control of steel-mill feeder circuits and as n breakers for medium capacity systems.

ey are designed to withstand frequent operan under heavy current conditions Contacts re heavy for ample current-carrying capacity, t are so arranged as to have low inertia for uick, positive action. Frame and all operating arts are rugged. Arcing time is minimized by fficient, magnetic arc chutes.

Applications range to 250 volts d-c and to 600 volts a-c. Interrupting rating is 25,000 rms amperes. Standard ampere ratings are from 3 to 600.

The Type KB illustrated is 3-pole, electrically operated. Design permits omission or addition of electrical operating mechanism without change in frame or in any other element of the structure Mountings include dead front, live front, individual steel enclosure—the last with or without pull-box and weatherproof if desired.

Catalog 1301 describes the Type KB We will send you a copy, or I-T-E engineers will gladly discuss the Type KB or other steel-mill equipment in the I-T-E line in the light of conditions in your mill.



ARC CHUTES are the magnetic type with iron vanes and blowout coils. Insulating barriers in the extinguishing chambers assist in extending and cooling the arcs and assure rapid circuit interruption every time. Arc chutes are quickly removable.

OPERATING MECHANISM opens and closes contacts whether operated manually with rotary handle or by solenoid. Direct linkage permits compact arrangement and rugged construction assures simultaneous closing of contacts in multipole breakers.

FRAME, solidly anchored to the circuit breaker panel, is of welded steel, shaped to provide rigid support for contact structure and closing mechanism. Indicator in front automatically shows position of contacts.

OPERATING HANDLE is rotated clockwise to close, counter-clockwise to open the circuit breaker. A turn of only ninety degrees is required. Same handle is supplied for manually and electrically operated breakers. Provision is made for three padlocks to lock breaker open.

CLOSING RELAY gives inherent protection against "pumping" or repetitions of the closing stroke. It can be of the trip-free type with maintained-contact control. Control switch must be opened and reclosed for each operation.

KLAMP-TITE SWITCHES

MT CIRCUIT BREAKERS

SWITCHGEAR

Representatives in Principal Cities

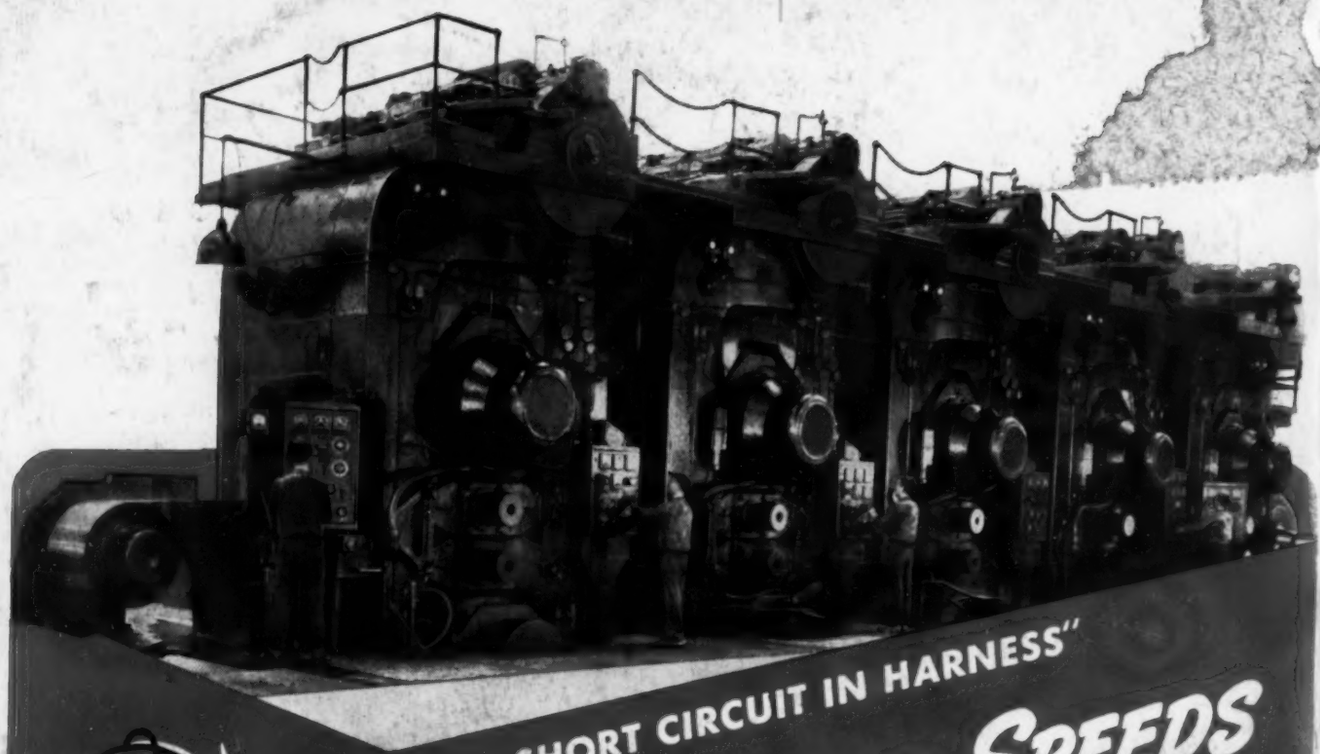
I-T-E

AIR SWITCHGEAR

IMMERSED IN AIR ENCASED IN STEEL

The Army-Navy "E" for Production Excellence

I-T-E CIRCUIT BREAKER CO., PHILADELPHIA 30, PA.



HOW "THE SHORT CIRCUIT IN HARNESS" HELPED BOOST STRIP SPEEDS . . . 50%

YOU are looking at a picture of the world's fastest cold strip mill! Rolling tin plate at the phenomenal speed of 3850 feet per minute, this new five-stand tandem mill is 50 per cent faster than any other cold strip mill. It holds the world's record for the production of tin plate.

One of the important contributing factors in attaining this improved operation was a revolutionary new control system centered around "the short circuit in harness"—the G-E AMPLIDYNE.

Yes, this same type of control is equally applicable to the cold strip mills you operate. Regardless of type, size, or speed, a properly engineered amplidyne system will also provide more accurate control of your mill.

When the time comes to resume full-scale production of strip, higher mill speeds will undoubtedly point the way to lower costs. Thus amplidynes deserve a prominent place in your modernization plans.

To assist you in applying the amplidyne, G-E engineers offer their full co-operation. They can be reached through the G-E office in your area.

HAVE YOU READ "The Short Circuit that Moves Mountains"? **This 36-page book tells how a short circuit, together with load-current compensation, was incorporated in the amplidyne to produce a generator-type amplifier of amazingly fast response and as high as 10,000-to-1 amplification. Ask for Bulletin GEA-4053. *General Electric Co., Schenectady, N. Y.***

HAVE YOU CONSIDERED AMPLIDYNES FOR THESE OTHER STEEL-MILL JOBS?

Saving melt-down time with automatic arc-furnace electrode positioning

Speeding skip operation on blast furnaces by permitting a higher rate of acceleration

Reducing rejects in flow-brightening electrolytic tin plate

Simplifying control and increasing accuracy of flying shears

Increasing speed of reversal and reducing maintenance of blooming mills

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750-230-8030

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